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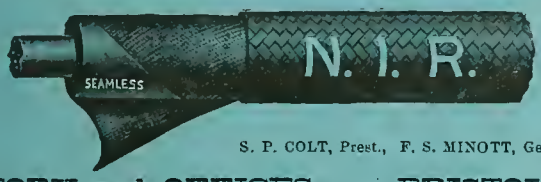

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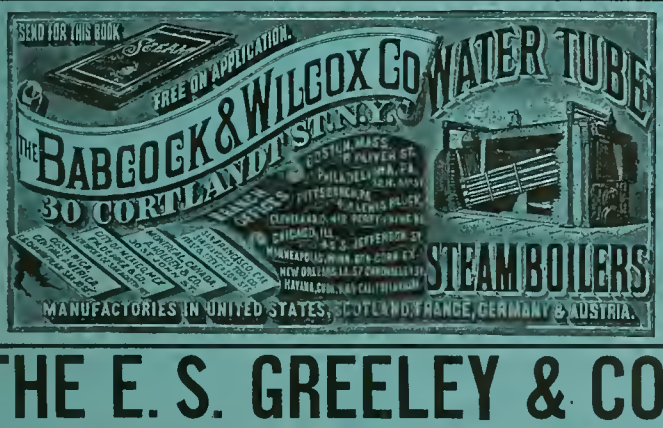

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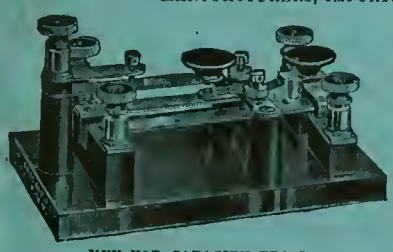

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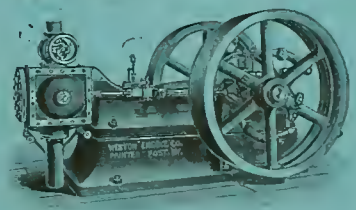

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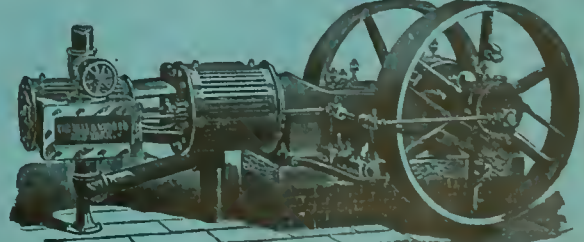

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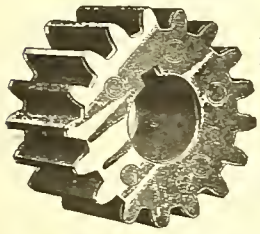

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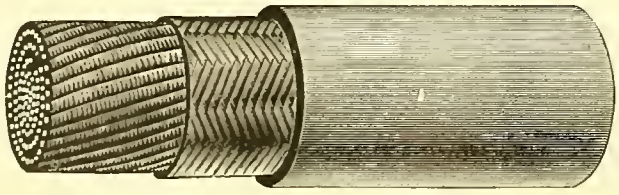

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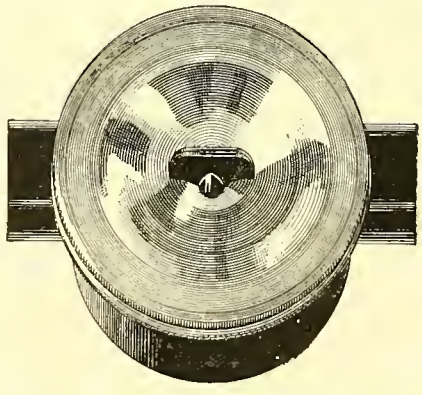

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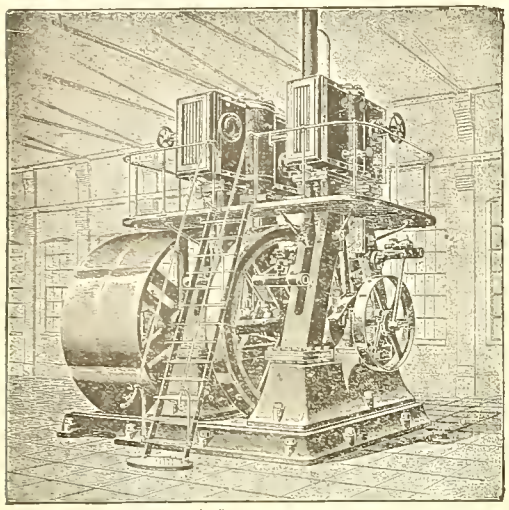

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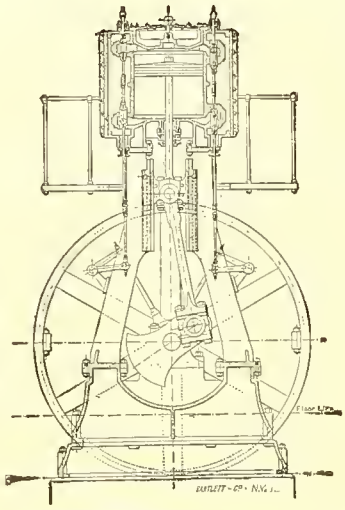

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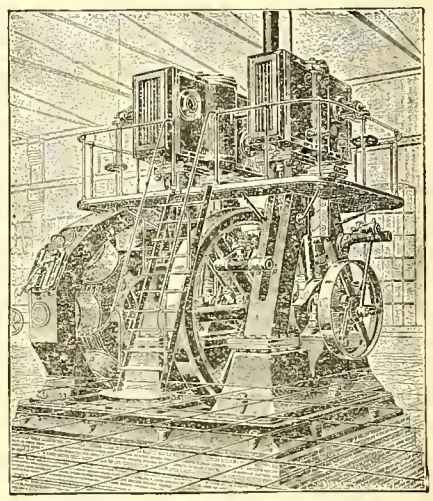

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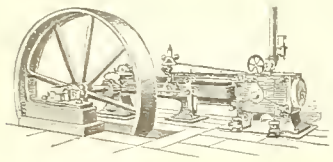

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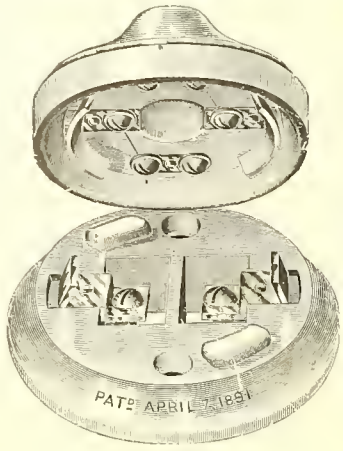

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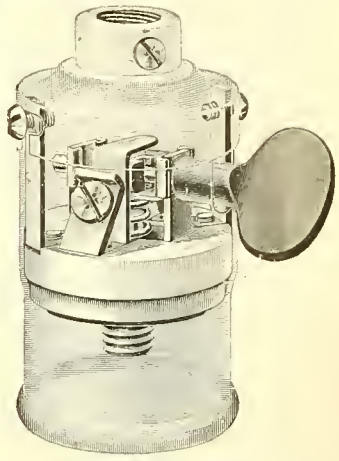

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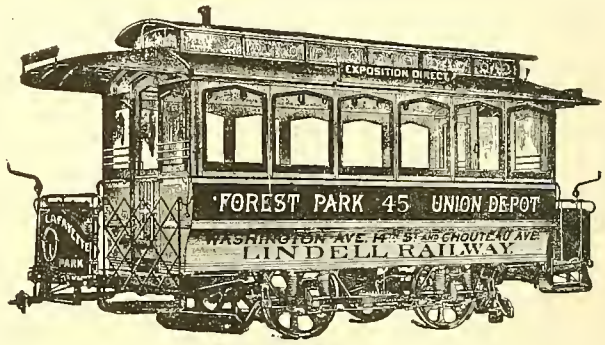

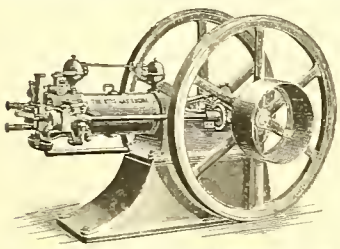

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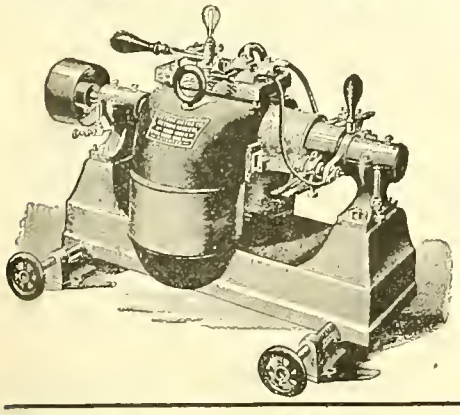

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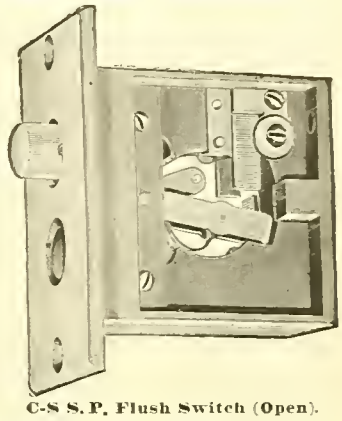

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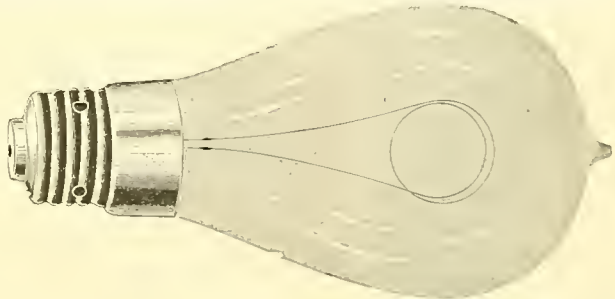

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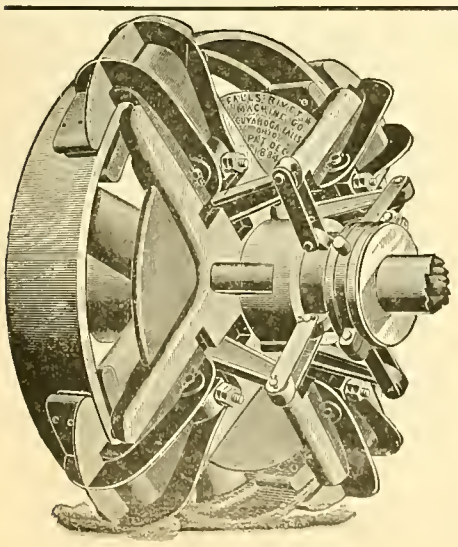

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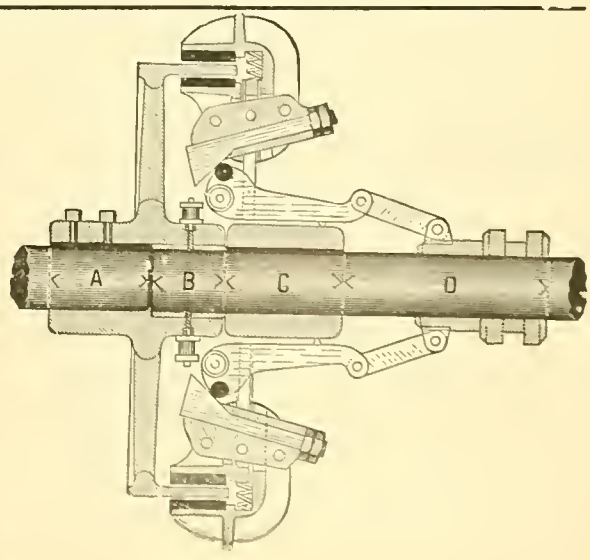

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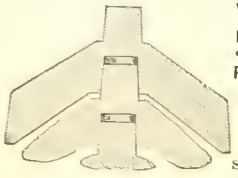

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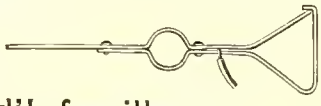

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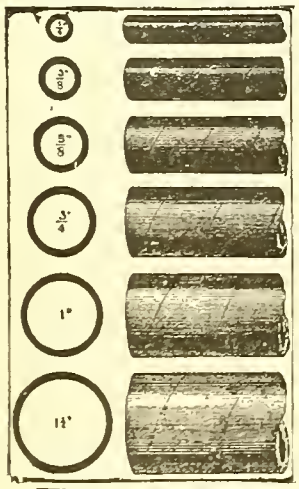

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Fourth. By reason of the manufacture of the lamps by special machinery and improved methods, by the use of nitrogen for preserving the carbons, and by means of pumping and charging apparatus recently perfected, **WE HAVE BEEN ABLE TO SO REDUCE THE COST OF MANUFACTURE AS TO FIX OUR PRICES FOR 8, 10 and 16 CANDLE POWER LAMPS AT 30 CENTS EACH, SUBJECT TO A DISCOUNT OF 10 PER CENT. TO OUR CENTRAL STATION CUSTOMERS,** and to others from 2½ per cent. upward, according to quantity, **WITH AN ALLOWANCE OF 10 CENTS FOR EVERY BURNED-OUT LAMP RETURNED UNBROKEN** to any one of our factories, making the net cost **OF RENEWALS FOR THE 8, 10 and 16 CANDLE POWER LAMPS 17 CENTS** to our central station customers. For 20 and 25 candle power lamps the prices will be 35 cents each, subject to the same discount and allowance for burned out lamps.

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We are also contemplating the erection, as the business develops, of "renewal stations" in all large cities such as New York, Boston, Philadelphia, Chicago, Cincinnati and St. Louis, thereby reducing the cost of shipment and return of lamps for renewals, and still further reducing the net cost of the lamps to our customers.

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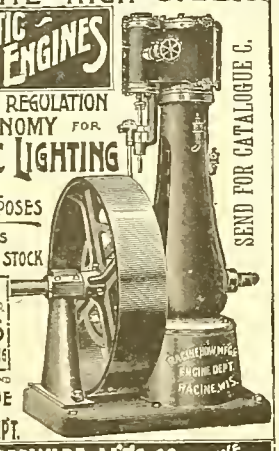

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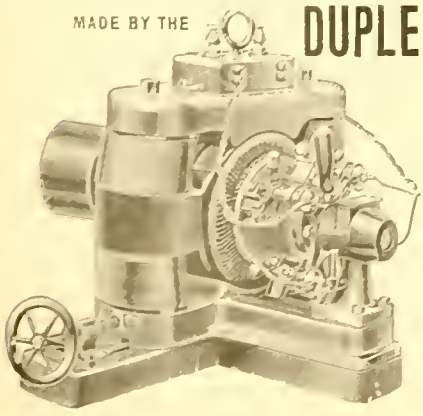

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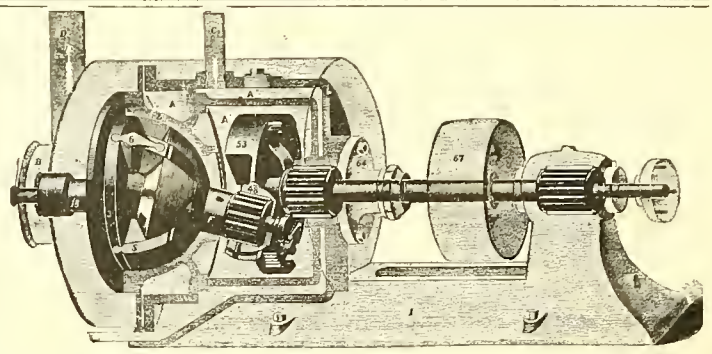

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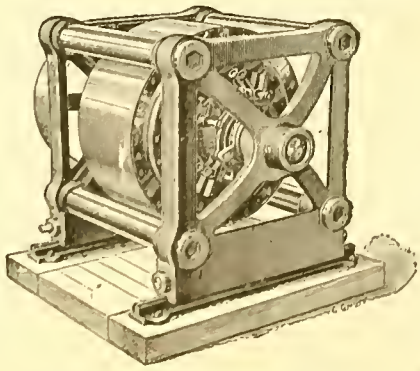

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Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, JANUARY 7, 1893. No. 1

The "Boosters" at the Twenty-seventh Street Edison Station, Chicago.

During the discussion which followed the reading of M. Willis' paper on the "Compound Winding of Generators from a Practical Standpoint," presented recently at the Chicago Electric club, mention was made by Louis A. Ferguson of an apparatus that the Chicago Edison company was using in connection with its Twenty-seventh street station for the purpose of compensating for feeder drop by raising the voltage in proportion to the total output.

As this arrangement, or "booster," as it is called, was recently put in and is now doing most satisfactory work, the accompanying illustrations and detailed description of its operation will not be without interest to low pressure direct current incandescent station men.

At the Twenty-seventh street station the company has a feeder running from Twenty-seventh street to Sixteenth street, and from there long mains run to Harmon court, on the Lake Front park. The company's business got ahead of it on the north end of the system, and in order to bring the pressure up there as much as possible without increasing the pressure on the bus bars too much, and thereby burning out the lamps in the other districts, the boosters were introduced. Instead of spending $40,000 for copper and labor the company bought two Edison motors, belted them direct to two series Edison dynamos specially built for the purpose, each for 25 volts and 300 amperes, and put them in direct circuit with the feeder, and as a result the pressure was brought up so that there was as good pressure there as was the case anywhere else in the system, without increasing the bus bar pressure. This arrangement is shown in Fig. 1.

Referring to the diagram, Fig. 2, and going more into details, it may be explained that in direct circuit with each outside pole of the feeder there is an Edison series dynamo wound for 25 volts and 300 amperes. Each dynamo is driven by a 12 kilowatt Edison motor in such direction as to add its electromotive force to the already existing electromotive force due to the generators in the station. The total current of the feeder passes through the armature and fields of the dynamo, and as the load increases the electromotive force of the booster increases in direct proportion, thus overcoming the loss in the feeder. As the load in the feeder decreases the electromotive force of the booster decreases, thus adding electromotive force to the line in proportion to the loss. Each booster is provided with a variable shunt on the series field, so that it may be adjusted to work automatically under variable loads. The motors which drive the boosters are fed directly from the bus bars, and are provided with main line regulators, so that their speed may be varied at will. By having an independent motor for each booster it is possible to give the proper pressure at the feeder end on both sides of the system, even when one side is more heavily loaded than the other, by simply varying the speed of the motor, and thus the electromotive force generated by the booster, to suit the load on that side of the system.

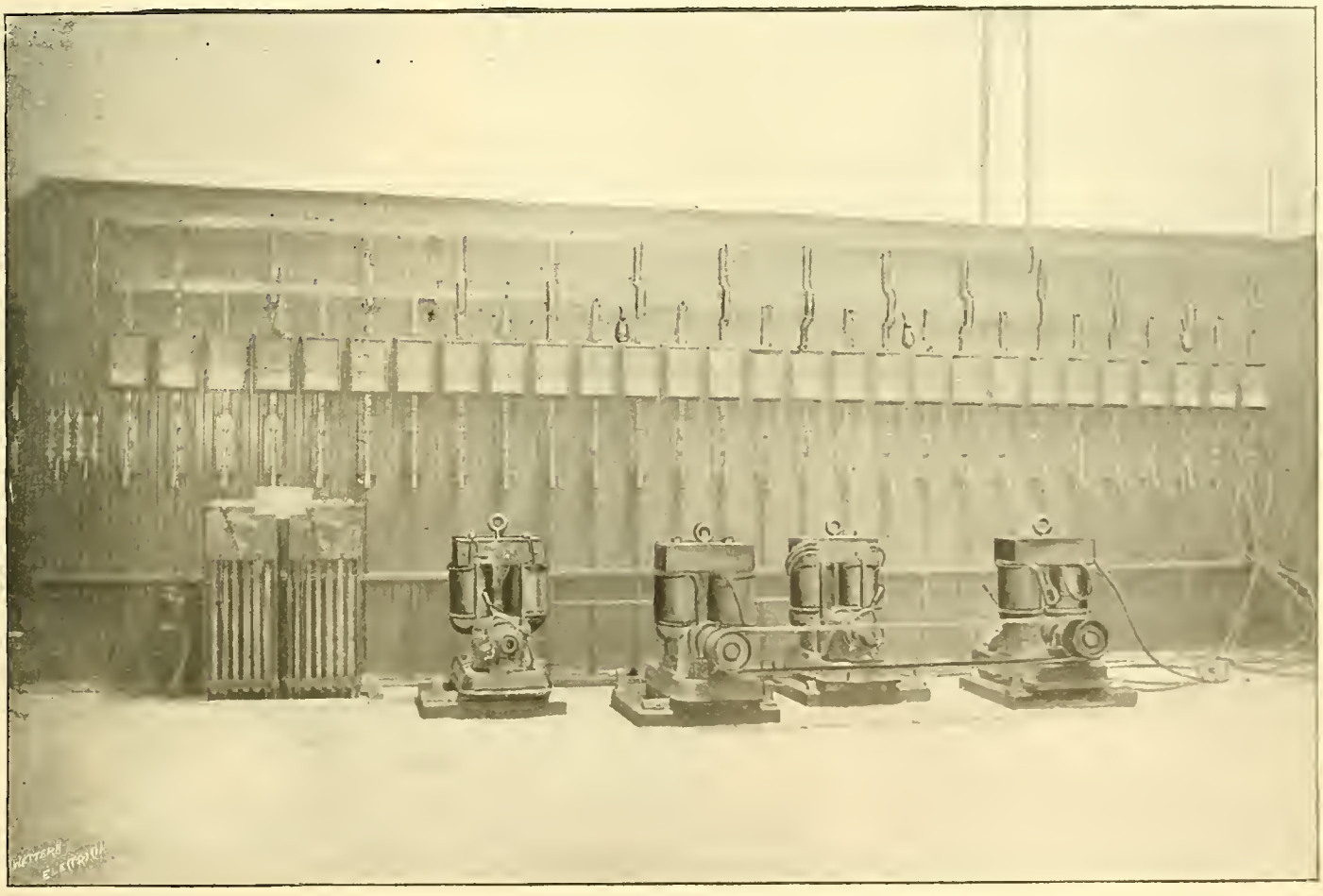


FIG 1. THE "BOOSTERS" AT THE TWENTY-SEVENTH STREET EDISON STATION, CHICAGO.

A gas engine is used to operate the electric light plant at the city and county hospital of San Francisco, and it is claimed that it keeps patients awake.

Milwaukee Car Shops Burned.

Early on the morning of December 25th the Milwaukee Street Railway company's car barns and shops on Kinnickinnic avenue were entirely destroyed by fire. The loss is about $200,000.

The fire was one of many that have visited Milwaukee during the last two months. It was discovered by W. S. Worden, for many years the watchman at the plant, who states that a few minutes after the "bum car" on the Bay View line had been run in, a loud explosion occurred in it, and flames burst out. The watchman tried to run the car out, but he did not succeed, and he then made a rush for a fire engine house diagonally across the street. The flames spread with great rapidity, and the whole building was a mass of flames by the time that the department arrived on the spot. On the strength of the watchman's story, the officers of the company at first claimed that the fire was of incendiary origin, but the police, after making an investigation, came to the conclusion that the fire was caused by an over-heated car stove. They deride the story of incendiarism. The street car people finally admitted that a car stove caused the fire.

The burned building was a large square structure. It had a frontage of 270 feet on Kinnickinnic avenue and a depth of 204 feet. It was of brick, two stories high. The barn proper was built several years ago at a cost of $35,000. The car shops were new and cost $30,000. They were fitted with the most improved machinery for car building and the shop included a store room filled with electrical supplies. In the car barn proper were all the cars in use on the Bay View and Forest Home lines. The

car shop was filled with new cars which were being fitted out for the various branches of the system. A large number of summer cars were stored on the second floor and in the basement were about thirty horses, which were saved by being released and driven out of the building. The number of cars destroyed was 111. Of these 55 were motor cars, and the balance summer cars, trailers and old horse cars. Most of the cars ordered for the Becker line and the big snow plow were burned. The insurance carried by the company is about $175,000. The fire simply burned itself out.

The service on the South Side lines was not discontinued, although the cars which were burned comprised half the rolling stock of the Villard system. The company's extra cars at its other barns were brought out, and still more cars were secured by reducing the number used on the other lines. Twelve cars were soon running on the Bay View line and eight on the Forest Home line.

The company will rebuild at once, and immediate steps will be taken to restore complete service. More cars will be added as soon as possible.

Great News from the Coast.

The Pacific Bear Electric & Power company was formed in Los Angeles recently with capital stock $1,000,000 and $60,000 subscribed. It controls the patents of the Columbian Light, Heat & Power company of Chicago, which cover a wide field, and in every instance are better than anything else in the market. From its prospectus the *Pacific Electrician* finds that among other things the company has a generator that produces from oil and water a fixed hydro-carbon gas superior to the best gas produced to date. Also a self-contained gas steam boiler, "the only one of its kind in the market." Its greatest invention, however, is the "Bear" dynamo. This dynamo is a daisy—its speed is marvelously slow, its power correspondingly great, and it uses "two bundles of induced wire." "Induced wire" is evidently another invention of Mr. Bear, and if it is properly patented ought to give him a lead-pipe cinch on the business. The Bear dynamo requires twenty-five per cent. less power to do the same work than any other dynamo, because (and here lies the secret) "the independent force of magnetism is harnessed to help turn the armature forward as generator." The motor is 100 per cent. better, as it "utilizes the magnetic force with double the working power of any other." The prospectus goes on to say, "We therefore unhesitatingly state that our electrical combination has no equal." This is probably true so far as California is concerned, since Tichenor, the mud battery electrician, is no longer with us. We have some electrical cranks, but their systems are not the equal of the Great Bear.

But not content with revolutionizing the electrical field, the company has a hydraulic motor, "combining in its mechanical construction the unequaled features of the best modern turbines." This is to be used to generate power for long-distance power transmission plants. The street-car problem is also solved. The company's plan for equipping street cars will make each car "a self-contained power that can be run onto any switch backward or forwards." (Upside down or inside out.) The car "can be thrown from the track" (by a simple twist of the wrist) "and run on the street, paved or otherwise." (It will also climb sand hills, and can be utilized as a tug boat.) It can go "around any obstruction on the track" (or crawl under it if necessary) by simply "placing upon the outer axle of each truck a motor that will produce a minimum of ten horse power." (It is ever thus—the greatest inventions are the simplest. A Bear motor on the outer axle solves the problem.)

The prospectus winds up with the following statement: "Our perfect system of insulation enables us to deliver the electrical energy shown at the dynamo any distance below fifty miles, without any appreciable loss." The company probably uses "induced wire," for with no wire known to ordinary, everyday electricians could such results be obtained, even allowing full credit to the "Bear" insulation. With the "harmless" dynamo in the north, and the "Bear" dynamo in the south, the electrical equilibrium of San Francisco is still steady.

The Mountain Electric company is negotiating with the council of Trinidad, Colo., with a view of furnishing an electric light system and building and operating an electric street railway in that city.

Direct Connected Gas Engine and Dynamo.

The accompanying cut illustrates an ingenious adaptation of a gas engine to a multipolar dynamo, and the method of accomplishing this purpose seems to leave little to be desired. The simplicity of the arrangement consists in bolting the armature direct to one of the fly wheels of the gas engine, taking care to leave sufficient space between it and the iron of the wheel to prevent any magnetic disturbance. The armature once fast to the fly wheel, it is only necessary to run the spool carrying the magnets up on the sliding rails, lower the brushes, and the dynamo is set up.

By this arrangement no especial support is required for the armature, and the fields can be removed in a moment to repair any individual magnet or to give access to the armature itself. The advantages claimed for this combination are: Least possible floor space; greatest safety in operation; high dynamo efficiency; owing to the absence of any loss in belt transmission with large machines the gas consumption for one 16 candle power lamp falls to about 60 l. per hour; uniformity of the current and of the light; heating of the dynamo, even by continued use, is so small that there is no appreciable drop in the voltage; the erection of the gas dynamo requires little if any more time than is required in setting up an ordinary gas engine; the initial cost and cost of maintenance is less, owing to the entire absence of belts, pillow blocks, clutches, etc.

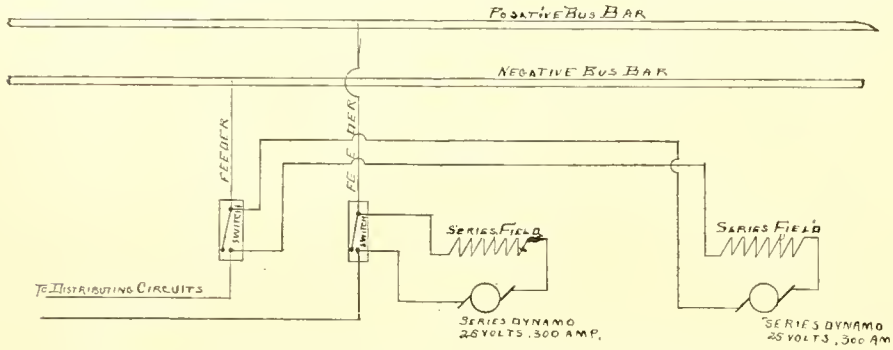
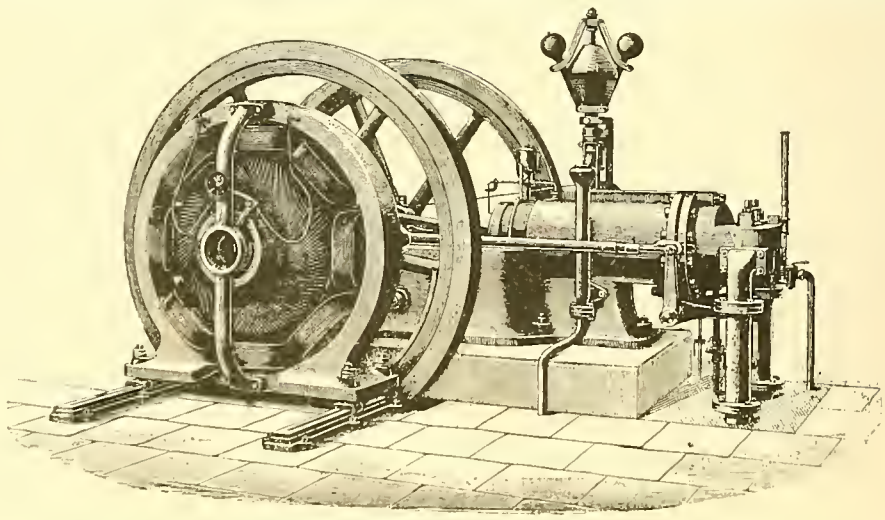


FIG. 2. THE "BOOSTERS" AT THE TWENTY-SEVENTH STREET EDISON STATION, CHICAGO.

The gas engine used in this combination possesses the following characteristics: The moving parts are exactly counterbalanced; the cylinder is made of hard iron, and can be easily replaced, should it become injured by careless handling; the ignition of the gas is accomplished by a special porcelain burner, so arranged that even at variable powers, the charge is ignited at the right moment; the speed is constant for all loads.

The armature is of the Gramme type, made of charcoal iron wire, and is fastened by means of bronze bolts to a bronze drum which in turn is fastened to the fly wheel. The current is taken off at only two points at an angular distance from each other of from 45 to 60 degrees.

This machine is manufactured and exploited by Koerting Brothers of Hanover, Germany.



DIRECT CONNECTED GAS ENGINE AND DYNAMO.

An electric railway is to be constructed between Pleasantville and Atlantic, Pa.

Otto Mears has perfected an arrangement for constructing the electric railway connecting Ouray and Ironton, Colo., for which a survey has been made. The line will be eight miles long, and will be used for freight as well as for passenger service.

New Westinghouse Lamp.

The Westinghouse company has made a further announcement in relation to its new lamp, which was illustrated and briefly described in the WESTERN ELECTRICIAN of October 22d. It is stated that the carbon filaments burn in an "attenuated atmosphere of nitrogen." As the lamp is separable, the renewal feature is dwelt upon, and the net cost of 16 candle power lamps is placed at 17 cents for central station customers. The circular concludes as follows:

The importance of the improvements in manufacture by which we have been enabled to offer these lamps at so low a price will be appreciated by all users who are aware of the constant deterioration in the carbon burners, and of the fact that the real commercial efficiency of a lamp is its average efficiency. With a constant amount of electric current the ordinary 16 candle power lamps rapidly fall below 10 candle power from deterioration of the carbon, when they must be renewed; and it results from this that the users, with cheaper lamps, will get from 15 to 20 per cent. more light from a given expenditure of electricity by a more frequent renewal of lamps than is now customary. Thus the low cost of the lamps may be made to add to the revenue of a lighting station in one of two ways, viz., either by giving a greater lighting capacity at the present cost of lamp renewals, or by actual saving in the cost of lamps with renewals made at the present period of renewal.

The problem of manufacturing a sufficient number of lamps to supply the entire demand expected from the users of electric light is a difficult one to meet quickly. We are preparing to turn out from 15,000 to 20,000 lamps daily, and in addition to this to renew the carbons in returned burned-out lamps to any extent that may be required. During the month of January we expect to be able to take care of all our customers who may have the new lamps, and rapidly thereafter to fill all the orders with which we may be favored.

We are also contemplating the erection, as the business develops, of "renewal stations" in all large cities such as New York, Boston, Philadelphia, Chicago, Cincinnati and St. Louis, thereby reducing the cost of shipment and return of lamps for renewals still further reducing the net cost of the lamps to our customers.

The 120 Ton Electric Traveling Crane at Watervliet.

At the recent convention of the American Society of Mechanical Engineers a paper on the "Performance of an Overland Traveling Crane Operated by a Single Electric Motor" was read by Anthony Victorin of West Troy, N. Y., the crane described being in the army gun factory at Watervliet Arsenal. The following synopsis of the paper is taken from the *Iron Age:*

The crane is operated by a single electric motor. The electric current is generated by a Thomson-Houston 656 horse power dynamo. Its voltage is 500, the speed 1,020 revolutions per minute. The crane has a span of 60 feet, a clear hoist of 40 feet, and a capacity of 120 gross tons. The capacity of the auxiliary hoist is 10 tons, hoist 56 feet. The total weight of the whole crane is about 150 tons. The bridge rests on eight double-flanged wheels (four on each side) of 36 inches diameter, the trolley on 16 inch wheels of 24 inches diameter. All wheels are arranged in pairs in compensating beams to avoid inconvenient results from want of uniformity in the level of the track rails. All wheels have also anti-friction steel roller bearings.

The motor is located at one end of the bridge. It receives current through a bare copper wire which is strung on insulated rollers along the crane ways. The motor is in permanent gear with the clutch shaft. This shaft is fitted with four clutch gears.

The crane performs the following operations: Bridge travel=40 and 80 feet per minute; trolley travel=50 and 100 feet per minute; main hoist=2, 4, 8 and 16 feet per minute; auxiliary hoist=20 and 40 feet per minute. Automatic brakes are provided to sustain the load in any position.

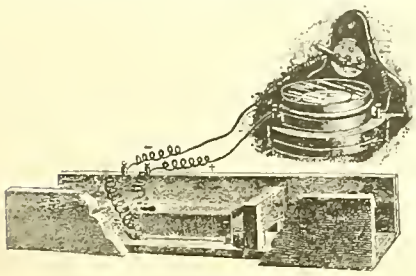
The trolley is provided with two grooved chain drums,

each being capable of winding 250 feet of 1¼ inch wrought iron main hoisting chain. These chain drums revolve loose on trolley axle shafts, 7 inches in diameter, with bronze-bushed bearings of 24 inches length at each end of drums.

The lower chain-sheave block contains six bronze-bushed sheaves of 30 inches diameter, while the upper block contains five sheaves of 33 inches diameter, each of which swivels independently of the others.

The chain is rove 12 times through the sheaves.

The chain drum of the auxiliary hoist is located above



ELECTRICAL ACID DELECTOR.

one of the main chain drums, and is grooved for a ¾ inch chain of sufficient length for 56 feet hoist.

The operating cage contains all manipulating levers, also the main switch, rheostat, etc.

All motions of the crane can be in operation simultaneously.

All gears of the crane mechanism are carefully cut, except the gears on the chain drums, which are cast; all bearings have bronze bushings. All working surfaces are finished smoothly and all parts are carefully adjusted.

But notwithstanding all possible care with respect to the construction and the arrangement of the crane mechanism, a great percentage of the driving power is absorbed by friction and the maximum efficiency of the main hoist is only about 40 per cent.; the lowest efficiency is about 20 per cent.

It may reasonably be assumed that the friction in the mechanism for the bridge travel and the trolley travel attains similar proportions, as given for the hoist; and that the efficiency ranges from about 25 per cent. for the slowest speeds, with the greatest number of gear trains in operation, to about 50 per cent. for the highest speeds, with fewer parts in operation.

The figures in the table permit various calculations as to the frictional resistance in certain parts of the crane:

	Amperes.	
Actual work of hoisting 12 ½ gross tons 2 feet p. m.	=50 27	H.P.=75
Theoretical work of hoisting 120 gross tons 2 feet p. m.	=16.3	H.P.=24.3
Frictional resistance in crane	=33 97	H.P.=50.7
Actual work of operating hoist 2 feet p. m. without load	=10.05	H.P.=15
Frictional resistance due to the load of 120 tons	=23.92	H.P.=·5.7

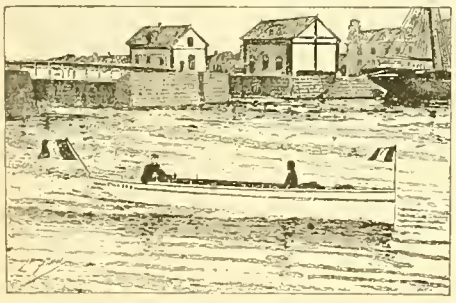
It was observed that the power required to bring the crane mechanism up to speed from the state of rest is considerable, and is from about 30 to 150 per cent. in excess of the power required for keeping an operation in continuance.

From the table referred to we take the following:

	Ft. per m.	Efficiency. Per cent.
Trolley travel	2.5	7
Trolley travel	1.5	47
Hoist	3.5	17
Hoist	15.	94
Hoist	3.5	16
Hoist	10.	48

French Electric Launch.

An electric launch designed by Lieutenant Chapelle has just been put in operation in the harbor of Cherbourg, France. The motor which drives the shaft is of the Edi-



FRENCH ELECTRIC LAUNCH.

son type, and current is furnished by 50 storage batteries enclosed in ebonite cells. The little craft, which is known as P'tit Bob, has been very successful in its trial trips.

The syndicate that has effected the purchase of the New Orleans City & Lake and the Crescent City railways of New Orleans, has been incorporated under the name of the New Orleans Traction company, limited. The capital stock of the company is $7,500,000, and work will at once be commenced to convert the roads into electric lines. E. E. Dennistoo is president, M. J. Hart vice-president, and Henry Seligman secretary and treasurer.

Keller-Degenhardt Electric Vehicle.

For some time the daily and technical papers have been publishing items relating to an electrical rolling chair that was intended by its designers for service at the World's Fair grounds during the exposition. The chief purpose of the builders of the chair was that it be employed for the transportation of visitors through the aisles of the buildings and about the grounds.

The vehicle referred to was one upon which Fred E. Degenhardt and E. E. Keller of Chicago have been at work for about a year. Illustrations representing this electrical chair have been presented at various times in different journals, but from the fact that the present vehicle was evolved after considerable experimenting, and is also the result of many changes, the accompanying illustration made from a photograph recently taken, will be particularly interesting as being the correct representation. It should be stated, however, that the vehicle here shown is only one of others of similar type projected by the manufacturer, the Columbian Electric Perambulator company. This company has, it is asserted, now in process of construction, a four wheeled vehicle capable of carrying four people at a maximum speed of about seven miles an hour, and that carriage, if it may be so designated, is constructed on entirely different lines; all ball bearings are employed and compensating, propelling and steering devices are provided. The Perambulator company believes, too, that it is not exaggeration to say that this type of vehicle will be the pleasure conveyance for use on city boulevards in the near future.

KELLER-DEGENHARDT ELECTRIC VEHICLE.

The vehicle as shown by the photographic reproduction, was designed to run on flat surfaces with a possible grade here and there of not to exceed ten per cent. at a speed of about four and a half miles an hour with a load of people. The electrical equipment of the chair consists essentially of a one horse power motor and a storage battery of six cells of the type made by the American Battery company, Chicago.

Several novelties are to be introduced on the vehicle now in process of construction. For instance electric lamps will be employed in the side lights of the vehicle; there will be an electric alarm bell for signal purposes, and also an ingenious mechanism for changing the speed of the chair without changing the speed of the motor.

The Volks Electric Railway company of Brighton, England, is asking authority for constructing a new line between Brighton and Rottingdean. The line is to be laid between the high and low water marks, and the car will be carried on steel standards some distance above the rails. The wheel base will be 40 by 24 feet, and the dock for passengers 16 by 40 feet. The idea appears to be to give tourists a sea trip without sea sickness, and is a development of the well-known traversing bridge between St. Malo and St. Servan. The current for driving the motor will be supplied by accumulators.

Electrical Acid Detector

The simple apparatus illustrated by the accompanying [illegible] was devised by two Frenchmen, R. and A. Collette, for the purpose of determining the degree of acidity in fermented beverages. It has been established that fermentation is better in proportion to that degree of acidity, which, while preserving all the forces of the alcoholic ferment, sterilizes or destroys the injurious ferments. It is therefore important to posess a knowledge of the degree of acidity.

The instrument is known as an electric acidimeter and consists essentially of a galvanic couple and an indicating galvanometer. The former is composed of two copper and zinc plates provided at the side with two longitudinal channels, and assembled by four insulated nuts fixed upon their angles and holding them in a parallel position. This couple, upon being immersed in any liquid that is somewhat acid, behaves like a true voltaic pile. The reaction of the acid upon the zinc gives rise to a current of electricity whose intensity is shown by a greater or less deflection of the needle of the sine tangent galvanometer serving as an indicating apparatus. The galvanometer used with this instrument possesses a dial graduated for currents corresponding to those that might be furnished by liquids of a very pronounced acidity, the middle graduation corresponding to a normal liquid. The readings therefore furnish a means of automatically registering the acidity of saccharine liquids set in fermentation. An electric bell can readily be attached to the galvanometer and arranged to ring at the moments of maximum and minimum acidity. The electric acidimeter is employed in several beet sugar and molasses refineries in France.

Keep the World's Fair Open Evenings.

The electrical fraternity has not forgotten the subject of evening closing at the World's Fair, and is keeping a close watch of the authorities of the exposition, waiting for a prompt repeal of the obnoxious seven o'clock closing rule. Following are some recent expressions of opinion:

Electrical Review, New York: Mr. Durborow of Illinois introduced in the House of Representatives last week a joint resolution to leave the matter of Sunday observance at the World's Fair within the power of the regularly constituted authorities of the exposition. This Sunday business is not so important to the electrical interests as the fact that the fair must be kept open in the evening, in order to properly display the electrical exhibits.

Electricity, London: The official and nominal closing hour is to remain 7 o'clock, and it is to be left to the discretion of the managing committee to decide whether they consider it wise from time to time to grant an extension from 8 until 11 o'clock. We should be very sorry indeed to leave the decision as to the wisdom of any act, be it ever so simple, to a body of men who draw up rules which are apparently to be set aside on from three to six days a week. We are now more than ever convinced that these concessions were wrung from the managing committee by

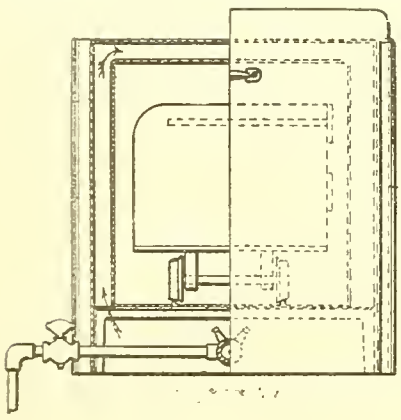
the all but unanimous protest of the electrical fraternity, and we strongly advise our American colleagues to persist in their decision not to participate in the exhibition until the managing committee declare their intention to keep the exhibition open until 11 o'clock on six days in the week.

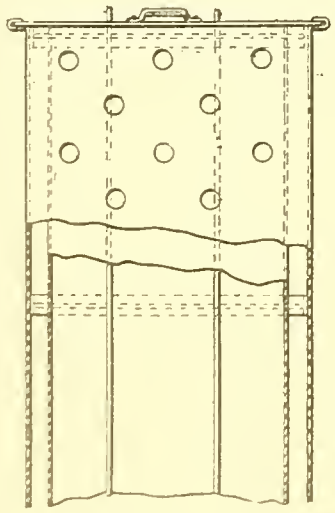
Kansas City Architect: There never has been so much interest in electricity as now in the United States. The greatest interest in the subject has been manifested by electricians in this and eastern countries because it has been deemed advisable by the managers of the World's Fair to provide a separate building in which to place the greater part of the electrical exhibits, thus adding a greater incentive for those engaged in electrical pursuits to excel in their exhibits. But the World's Fair commission seems to have forgotten that the greatest glory of electricity is seen at night, and proposes to close the exhibition every night at seven o'clock, or possibly open the electricity building two or three nights during the week. Col. R. C. Clowry, with the commendable energy which characterizes all he undertakes, steps in and adds his protest to the plan of the managers, and we sincerely hope his protest may have the desired effect. The electrical exhibit should at least be open every week day night until 10 o'clock. Of course we do not expect it will be open on Sunday, but the exposition will be the greatest attraction of the world; millions of people from all over the world will be in attendance.' A proper exhibit which would do credit to the craft cannot be made in the daytime, therefore we desire

FIG. 4. JOINING ARC LIGHT CARBON STUBS.

to add our voice again against shutting the doors at 7 o'clock, as contemplated. The WESTERN ELECTRICIAN has published a long list of persons and friends petitioning against closing so early, and we trust the managers may find it profitable to heed their petition.

Manufacturers' Record, Baltimore: The announcement that the gates would be closed evenings with the exceptions





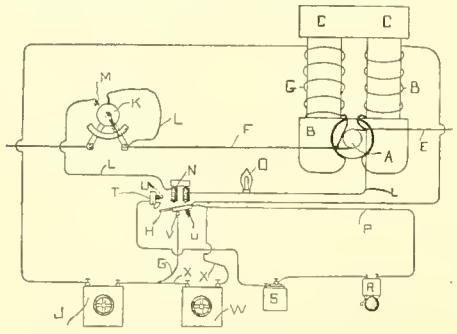
FIGS. 5 AND 6. JOINING ARC LIGHT CARBON STUBS.

of special nights raised a storm of opposition, especially from electrical manufacturers, who protested that their exhibits would be relatively insignificant if such action were taken. The fair management subsequently modified its declaration by intimating that from three to six evenings would be exceptional occasions. This concession was by no means satisfactory to the protesting electrical exhibitors, who insisted upon a positive assurance that the gates were to be open every evening. Their unanimity, earnestness and ability to enlist influence in their cause lead to a belief that the fair authorities will be compelled to grant their demand, especially in view of the fact that the public has from the outset regarded the electrical exhibit as one of the great attractions of the exposition.

Badt's Safety Device for Dynamos.

The accompanying diagram illustrates an arrangement devised by F. B. Badt, Chicago, for reducing the current of a dynamo when it has passed beyond a given point.

Referring to the cut, *G* is the field magnet coil conductor, which normally includes the armature *H* and the resistance *J*. *K* is an ammeter in series in the circuit *E F*. *L* is a local circuit from one brush of the dynamo to the other, including the circuit-closing device *M*, controlled by the ammeter, the magnet *N*, which controls the armature *H*, and the lamp *O*. *P* is a local circuit including the bell *R*, the battery cell *S*, the armature *M*, and the contact-point and catch *T*. *U U* are springs tending, respectively, to retract the armature *H* from its magnet onto the contact, point *V* and the catch *T* into its normal position, as shown. *W* is an extra or controlling resistance in the short circuit *X*, and therefore normally cut out by the circuit *G* being closed through the armature *H*. These several parts could, of course, be greatly altered in their various relations—as, for example, the current to energize the magnet *N* need



BADT'S SAFETY DEVICE FOR DYNAMOS.

not, of course, be taken from the machine itself, as this current will flow only so long as the circuit-closer *M* is closed in any event. The lamp *O*, too, is not indispensable, as any other resistance could be used, or the magnet *N* could itself be wound so as to serve as such resistance. It is equally obvious that a series of magnets and resistances could be employed, the latter to be successively thrown into the field magnet circuit of the machine.

The use and operation of the arrangement are as follows: Assuming a device constructed substantially as shown in the drawing and assuming that it is desired to maintain a current which shall not pass beyond a certain fixed limit—say, for example, a thousand amperes—the amperemeter will be adjusted so that it will operate the circuit closer *M* when the current has passed to or beyond such predetermined limit. When this circuit-closer is thus operated and its local circuit closed, the magnet *N* will be energized, and will immediately draw up the armature *H*. Previous to this the field magnet circuit *G* will have been complete through the armature *H* and the resistance *J*; but when the armature *H* is thus raised by the magnet the contact-point *V* is disengaged from that armature, and the field-magnet circuit will only be completed through the local circuit *N* and the extra resistance *W*.

In other words, an extra resistance will be thrown into the field magnet circuit and the strength of the field will be reduced, and the main current will be correspondingly reduced, thus bringing it below such fixed limit. The armature will be held in this position by the spring-catch and circuit-closer *T* until disengaged by hand, for the conditions which have caused the current to thus rise beyond its proper limit will require some time for their readjustment. As soon as this armature *H* is thus drawn up and its outer end rests upon the spring-catch and circuit-closer *T* the local circuit *P* will be closed through the bell R and battery S, and thus an alarm will be given. When the conditions have been changed and the device readjusted, the operator will by hand disengage the armature *H* from the catch *T*, and the parts of the dynamo safety device will resume their normal positions.

Joining Arc Light Carbon Stubs.

A New Hampshire man, Nathan P. Stevens of Concord, has invented a process of uniting broken pieces of

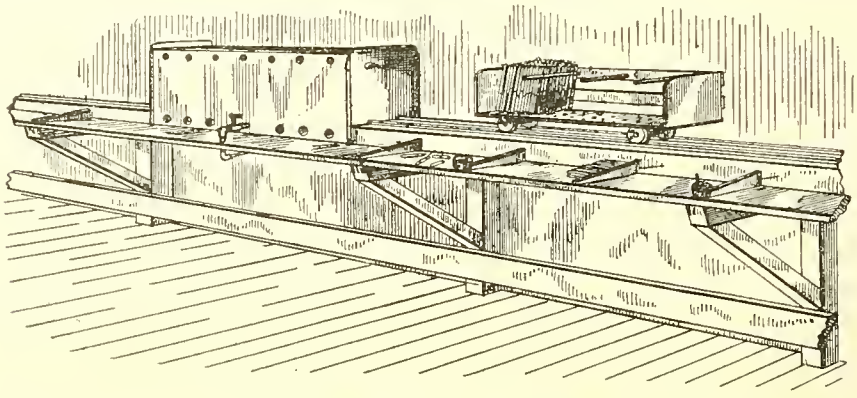


FIG. 1. JOINING ARC LIGHT CARBON STUBS.

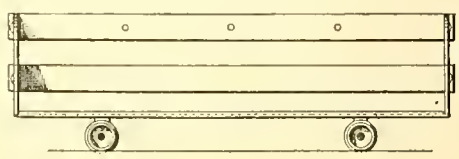
arc light carbons that should be of interest to central station men, in that it seems to offer a means through which considerable saving can be effected.

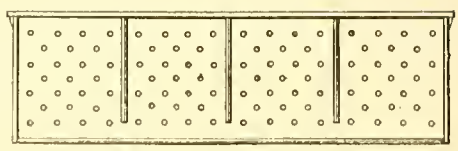
Fragments of arc light carbons are removed from lamps every day by the trimmers, and replaced by new carbons. Ordinarily these pieces of carbon which remain unburned in the lamps after the current has been cut off for the night are a total loss to the lighting company, as the pieces are much too short to burn a second night. The object of Mr. Stevens' process is to utilize these waste pieces of carbon.

The various experiments which he made during the past three years resulted in nothing better than his obtaining the mixture of certain materials that made a cement which, under the most favorable circumstances, would stick pieces of carbon together sufficiently strong to be utilized for the lower part of a lamp only; and if used in the upper holder by mistake the pieces would invariably fall apart and the lamp go out. These results all followed the use of any material as a cement which hardened by exposure to the air and without the application of artificial heat.

To overcome the foregoing difficulties he found it necessary to use for a cement such materials as would be readily applied in the form of a thin paste, and rendered sufficiently hard by being baked. And to this end the process consists in uniting two or more pieces of carbon by means of adhesive material which will become hard and strong when subjected to heat, and in baking them until the joints are thoroughly hard and dry.

The accompanying cuts represent Mr. Stevens' apparatus. Fig. 1 shows in perspective a section of the bench for the operatives, one car, the track, and the baking oven. Fig. 2 is a side elevation of a car, and Fig. 3 is a





FIGS. 2 AND 3. JOINING ARC LIGHT CARBON STUBS.

plan. Fig. 4 is a perspective view showing a case upon which the pieces of carbon are placed when stuck together, for the purpose of holding them in perfect alignment while being baked. Fig. 5 represents the oven partly in cross section and partly in end elevation, and Fig. 6 is a sectional plan.

To carry the process into effect he faces off the ends of the pieces of carbon to be united, either flat, one concave and the other convex, or in a form that more nearly resembles a plug socket. Then he applies to the ends to be joined an adhesive substance formed of carbon dust, or pulverized carbon and coal tar, which is mixed in about equal quantities, and kept while being used at a temper

ature just below boiling, and a consistency of thin paste. He then places the carbon thus formed of pieces upon a case or holder, Fig 4, made of sheet steel in the form of channel iron, in which it may be stood up in an oven to be baked; but this channeled holder is not essential except when the pieces to be joined together are trimmed off flat, or in a form not calculated to hold the pieces in perfect alignment, as shown in Fig. 4. The carbons must then be placed in an oven and baked for from one-half to three-quarters of an hour, and when removed and cooled they will, he states, be equal to new carbons and thoroughly homogeneous.

To join these pieces together economically it should be done systematically, and in practice Mr. Stevens has found some such apparatus as shown in the drawings, to be very satisfactory. A bench having low partitions across its top at convenient distance to accommodate an operative between each, is provided with a slightly elevated track upon which cars are placed. The cars are provided with perforations to let the hot air through their floors, and are open at the top and front side. They may have solid ends and slats on the back side connecting their ends as shown. A car is moved along the track in front of the operatives, each contributing to its load, which may consist of five or six hundred carbons. The door of the baking oven is then opened and the car rolled in, other cars being loaded in the same manner. After a car load has been baked the door at the opposite end of the oven is opened and the car rolled along the track to the other operatives, who remove the carbons and pack them for shipment. The track should extend around the room, so that the cars may be rolled back to the starting point, or from one set of operatives to the other.

The baking oven, Figs. 5 and 6, is formed of sheet iron and heated by gas burners arranged upon a pipe placed longitudinally under the center of the car track. The oven contains an inner shell, which incloses the car load of carbons, and the heat from the gas burners rises at either side of this inner shell, between its walls and those of the outer shell, the latter being perforated for the admission of air, and for the escape of products of combustion. Ways are provided at each end, in which to mount a sliding door.

"Charged with 2,000 Olms."

A Duluth paper is responsible for this: The electric motor which Mr. Huot removed from his old location to 112 West Superior street has been doing great damage. Mr. Huot attempted to start his motor for the first time yesterday, and to his surprise found that the current entered the motor, passed through the belting and then into the heavy shafting; from the shafting it was found that the current had connected with the ice crusher where they were mixing salt and ice. The colors which were seen coming from the wet salt were beautiful. His ice cream maker when removing the cans and bricks of ices and cream found to his sorrow that the cans were also charged with 2,000 olms of electricity. Strange to say the creams were not melted nor was the holly or mistletoe damaged.

On December 24th a strike was declared by all the electric linemen employed by the Toledo Electric Light and Western Electric Light & Power, Toledo Electric Railway and Consolidated Street Railway companies of Toledo. The men gave no warning of what they proposed to do, and the citizens were unaware that there was any trouble until the lights all went out and the cars stopped. The linemen held a meeting which lasted nearly all night, and finally decided to strike until the companies granted an increase of 10 per cent. in wages. The companies had men out repairing the cuts in the wires which caused the darkness. Cars were running all night on the 25th, but when the lights were turned on the cutting began again.

English Motor Trucks.

Although the growth of public sentiment approving the introduction of the electric railway in England has been remarkably slow compared with the results achieved in this country, much interest is now taken in this subject on the other side of the water, and a number of projects are on foot. Several leading English electrical engineers are now devoting much attention to electric traction, and it is probable that the next few years will witness a marked transatlantic extension in this direction. Among those whose professional advice is sought in connection with electric railway plans is Anthony Reckenzaun, well known as an electrician in Europe, where he is consulting electrical engineer to several large concerns, and in America. Mr. Reckenzaun is the inventor of the motor trucks shown in the accompanying illustrations. The single motor truck, Fig. 1, is the newer design, and is in use on the electric railway at Brighton. The double motor truck, Fig. 2, is in service at Leeds, where the equipments are manufactured by Greenwood & Batley. It is probable, also, that sixty of these trucks will be used on two projected electric roads.

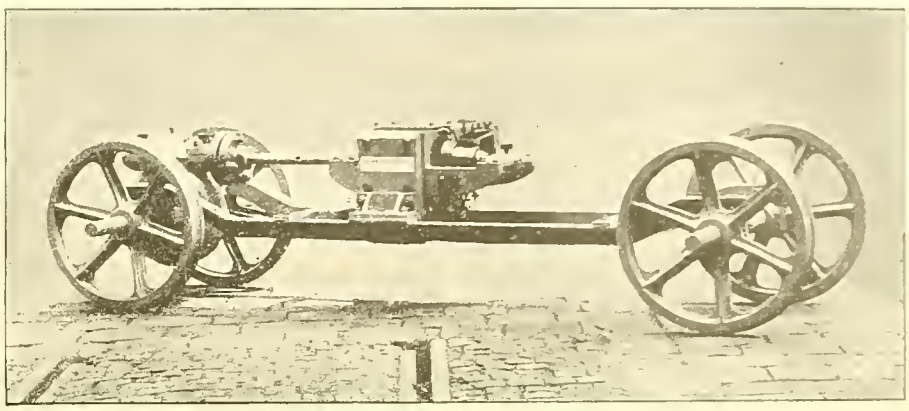


FIG. 1. ENGLISH MOTOR TRUCKS.

The principal feature of this system is the employment of worm gearing instead of spur gears. Mr. Reckenzaun says that the use of this gearing leaves nothing to be desired. Twelve sets of this gearing have been at work for eighteen months at Marseilles, France, giving entire satisfaction, it is said. The inventor claims for the motors high efficiency, and asserts that the gearing is more efficient than double reduction, although it must be rated as single reduction. The reduction is eight to one. Other advantages claimed for this system are noiselessness, durability and compactness.

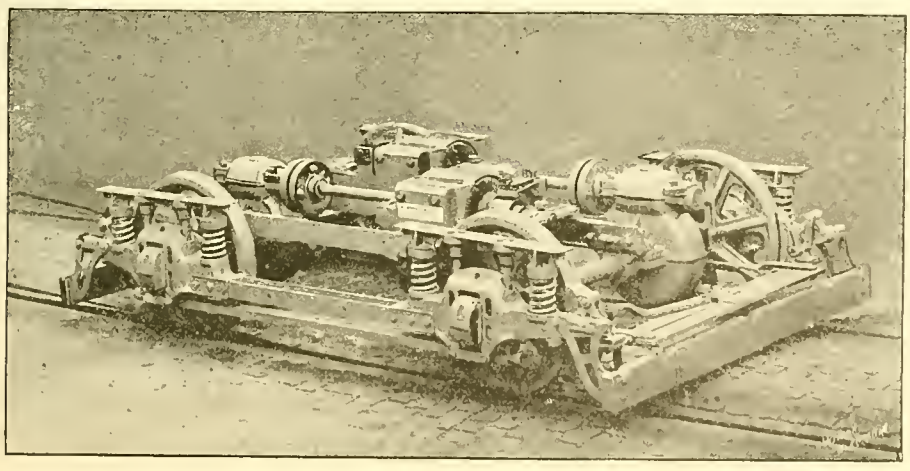


FIG. 2. ENGLISH MOTOR TRUCKS.

Electricity in a Baltimore House.

Gen. Thomas J. Shryock and Mrs. Shryock, who have been traveling extensively through Europe, arrived at their home in Baltimore a short time ago. As soon as they could get themselves and their baggage through the hands of the custom house officers, Gen. and Mrs. Shryock hurried on to this city to see their little children, from whom they had been separated for some time. The children had also looked forward to the reunion, and had prepared a welcome home that greatly surprised as well as pleased their parents.

Before his departure abroad, Gen. Shryock had instructed Electrician Gwynne E. Painter of Baltimore to thoroughly equip his house with an electric lighting plant. This work was completed recently. The relatives and children of the general constructed an arch about eighteen inches wide, which was thrown across the foot of the stairway. This arch was covered with paper, which, in turn, was hidden by choice chrysanthemum blooms of various colors, so arranged as to form the words "Welcome Home." In the center of the arch was a photograph of the general's baby daughter. Behind this arch Mr. Painter placed a number of electric lights, and, when lighted, the effect was very beautiful. About the hour of General and Mrs. Shryock's expected arrival the children gathered in the hallway, beneath the arch, and when their parents entered the door the electric lights were turned on throughout the house, forming a striking illumination.

Later in the evening Gen. Shryock examined the electrical lighting of his house, and expressed his pleasure at its neatness and completeness. There are few, if any, private residences in the country better equipped. The house is lighted from cellar to garret with electric light. The upper floors of the house are lighted with plain clear glass lamps, each of 16 candle power. The lower floor contains many beautiful novelties. The center hall light is a single 16 candle power lamp hidden in an ornamental covering. The large candelabra at the foot of the stairway has a crown of Newell electric lights, representing candles, each of 4 candle power. The red room, to the left of the hall, in which are several choice paintings, is lighted by two sets of lights, controlled by as many switches. The switch in the back of the room lights a semi-circle of overhead lights, each of 16 candle power, and so arranged as to throw their light directly upon the paintings. There are several lights about the sides of the room, and one drop-light, with a heavy dark shade, which can be carried around at will. The other switch controls the lights in the front of the room. Behind this room is the billiard room, which is lighted by lights with various colored globes, arranged around the top of the room.

In the parlor, which is to the right of the entrance, the electrical display is excellent. A shell-fish, with electric lights issuing from its mouth and eyes, swings over the door, while the room is lighted by three overhead lights, each containing five 16 candle power electric lamps, covered by a thick, semi-transparent white globe. Each one or all of these may be lighted at will. In the rear of the room there swings a red light which shines through an ornamented shade. The dining-room, in the rear of the parlor, is lighted by electric lights arranged about the chandelier. Directly beneath the chandelier, and apparently fastened to it, is a globe similar to the one in the parlor, in which are hidden several electric lights. When turned on these emit a soft, white light. Around the outer edge of the chandelier are arranged a circle of red lights. The greatest novelty, however, is exhibited in the lighting of three large plate glass cabinets, in which are kept fine china and cut-glass dishes and ornaments. Two of these are in the dining room and one in the hall. The latter contains the fancy and rare china. On the interior of this cupboard and from the top swing a number of 4 candle power electric lights set in globes representative of icicles, while under some of the most delicate pieces of china are tiny lights, which illuminate them, bringing out the hand-painting upon them, and exhibiting their beauty in all its detail.

The cupboard is lighted by several large lights. One of the cupboards in the dining-room is similarly lighted, while the other, containing many cut-glass pieces, is lighted with delicate red lights. Icicle lights also drop from the top of this cupboard, while at the base red lights shine out from two glass side doors, leaving the center door dark, thus giving the effect of fire. The entire effect of this lighting is beautiful in the extreme. Several ornamental switch plates, from which all or each separate light can be controlled, are arranged about the respective rooms and hallway. They are all flush with the wall, and so do not disfigure it in any respect.

A bill has been introduced in Congress to incorporate the Washington & Marlboro Electric Railroad company of the District of Columbia. The company is authorized to build a single or double track railway, beginning at Eighth street and Pennsylvania avenue, southeast, and run on Pennsylvania avenue across the Eastern branch bridge, then on Pennsylvania avenue extended to Bowen road, and along said road to the boundary of the District of Columbia, there connecting with the line of the Prince George's county branch of the Washington & Marlboro railway. The company is authorized to issue stock to the amount of $250,000.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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IT IS gratifying to observe that an effort is being made to secure a definite and final code of rules for the World's Fair. The directors propose to take some action at last, and it is reported that the rules adopted by the commission are likely to be confirmed. That portion of these rules referring to electric light and power has already been given in the WESTERN ELECTRICIAN. While the directors are about it, why not do an act of justice to the electrical interests of the country, and expunge the seven o'clock closing rule entirely? Or, if it is the intention to have evening sessions for an extra admission fee, why not come out boldly with a provision for six evening sessions a week? Nothing can possibly be gained by throwing the whole electrical display into uncertainty and by trying to hoodwink the public in relation to the subject of evening admission.

BY an unfortunate coincidence four large fires have occurred within a month or so in buildings belonging to electric light or power companies. Central station companies at Buffalo and Des Moines and the Milwaukee and Boston street car companies have all suffered severely. Several lives were lost and a large amount of property destroyed. The latest of these misfortunes occurred in Milwaukee, where the car barns and shops on Kinnickinnic avenue were burned last week, entailing a heavy loss. This fire derived additional interest from the fact that it was at first ascribed to an explosion which was thought to be incendiary, and even attributed to anarchists. Later investigation, however, developed the fact that the flames were caused by an over-heated car stove—another argument in favor of electric heating. Amid the general regret at these casualties it is gratifying to observe that not one of the fires was caused by electricity.

ELECTRIC railway interests are active in Boston, and it is possible that before many years that historic city may not be compelled to rely upon surface roads exclusively. A combined overhead and underground system has been planned by the West End company. It includes a tunnel under Boston's famous pleasure-ground, the Common, and legislative sanction is now sought for the scheme. The overhead portion of the road is to start in Roxbury and come down to the vicinity of the business portion of the city. The track will then be depressed under ground, going under the whole length of the Common and come out in the vicinity of Scollay square. From this another elevated line would run to Charlestown. It is also proposed to tunnel under the Common and pass directly under the crest of Beacon Hill and the state house, and come out in the section of the city near the northern and eastern railroad stations. Whatever plan is adopted, electricity will undoubtedly be employed to transmit the motive power, and the plan should have the hearty support of all interested in the business.

THE Detroit city authorities have caught the fever for municipal ownership of electric lighting plants and are now seeking the passage of an act by the Legislature which will allow them to engage in the business. In speaking of the project, an officer of the company says: "We consider that it would be just as proper for the corporation of the city of Detroit to take the wealth and credit of all its citizens and compete with the invested capital of a portion of its citizens in any of the various industries of this city as to enter the electric lighting business. If a municipality can sell electricity, or produce it for the general use of its citizens, why should it not manage all other industries and trades of this country? All cities have large amounts of printing done; then why not have the city own and run its paper mills and printing offices? Also, its street cars, its shoe factories, its woolen and cotton mills, own its own mines and sell its own coal? Cities also use immense quantities of stone, brick and building materials, etc.; then why not have quarries and brick and lumber yards, and even sawmills? And so on with every industry requiring the investment of private capital." These sentiments are just and reasonable and should command the approval of all thoughtful men.

THE latest news of the incandescent lamp litigation comes from Pittsburg, where the General Electric company has secured a decree of injunction restraining the Westinghouse Electric & Manufacturing company from manufacturing and selling lamps infringing the Edison patent. This move appears to be the logical sequence of the Sawyer-Man decision, owing to the well-known fact that the Westinghouse and Sawyer-Man companies, although possessing legally distinct existences, are practically under one ownership. The new decree has no bearing whatever on the merits of the new Westinghouse lamp, which is now about due on the market. The General Electric company, it seems, alleged that an evasion had been practiced by the Westinghouse company in transferring the manufacture of the old lamps to its Pittsburg factories after the Sawyer-Man decision had been announced. This, however, was vigorously denied, affidavits being made by the Westinghouse company showing that since the date of the decree in question no lamp of the description set forth by the plaintiff had been made in any of its factories. The Pittsburg company did not appear to be greatly disturbed at the prospect of the injunction, and made little opposition to the issuance of the decree, simply demanding the condition included in the Sawyer-Man decision—that the Edison company be compelled to sell lamps to existing plants. This clause is a very important one and one that cannot fail to play a prominent part in the history of the lamp business for the next year.

The Pittsburg decision undoubtedly marks the conclusion of the long struggle between the Edison company and the interests represented in the Westinghouse, United States and Sawyer Man companies. It now remains for the General Electric company to announce its policy toward the smaller lamp manufacturers. It will be well if this decision is speedily made public, thus ending the present uncertainty. No one who has at heart the welfare of the electrical business at large will hope for an other than liberal policy. Fair treatment of the outside companies will stimulate the electrical business all over the country, and it does not need an elaborate argument to prove that whatever improves the electrical business of the whole country is decidedly to the interest of the General Electric company.

BEGINNING with this number, the WESTERN ELECTRICIAN enters upon its twelfth volume. In some respects this volume will be the most important in the history of the paper. It will witness the opening of the World's Columbian Exposition, with the operation of the great central station and the multiform applications of electricity shown in service or as exhibits. Everybody interested in electricity, from Mr. Edison and Prof. Thomson down to the humblest lineman and the youngest student, will want to know all about the latest advances of this fascinating science as shown at the great World's Fair. This desire the WESTERN ELECTRICIAN proposes to gratify by taking its readers on weekly visits to the electrical features at Jackson Park. Confining itself in the future, as in the past, to the electrical and directly allied interests at the fair, this journal will endeavor to present a complete and copiously illustrated record of all matters of interest or instruction fairly comprehended under the heading "Electricity at the World's Fair." No pains or expense will be spared to accomplish this result and to make a running account which no one interested in the subject can miss without a distinct sacrifice.

The WESTERN ELECTRICIAN is able to point to what it has already accomplished in this direction as a guaranty of future performance. It was the first to present the plans of the electrical building with the architects' description; the first to give a perspective view of the structure—a picture, by the way, that was subsequently adopted by the World's Fair authorities and which appeared in a large number of technical journals; the first to establish a separate department for the electrical news of the World's Fair, and the first to present an illustrated weekly record of the progress that has been made. No other electrical paper has approached it in extent and accuracy of matter or number of illustrations. With peculiar advantages of location, equipment and experience, it is proposed to equa this record in the future and surpass it if possible.

ACCORDING to a Chicago Sunday paper, Berlin, Germany, bids fair to have an underground electric railway system which will rival that embodied in the rapid transit tunnel scheme proposed for New York city. For some time reports have been coming to this side of the water to the effect that the Berliners were to remove all tracks from the streets and construct a mammoth subterranean electric railway system that would accommodate all the passenger traffic of the German metropolis. The movement was set on foot by a local electric company and the construction plans, it is said, have now been given to the public. The work, it is estimated, will cost on an average $212,500 per mile.

Without discussing the probability of the execution of this project, it may be said that the present situation in New York constitutes an opportunity for the conservative Germans to secure experience free of expense.

For about two years a number of the best engineers in the United States have been at work preparing plans for the relief of New York city through a subterranean electric railway system. After an immense amount of labor on the part, not only of the engineers, but of the business men whose one object was to formulate a thoroughly practical plan, the New York scheme now appears as a failure—at least so the matter stands to-day—in so far as it has not found favor with the capitalists.

If, then, Berlin is in earnest and really wants rapid transit by means of tunnels beneath the city, our German friends might do worse than to carefully study the plans proposed in New York. We would not like to say that the money for the New York enterprise may not eventually be forthcoming, but we do say that the prospect at present is not encouraging. If the German city, therefore, should carry out the proposed work it would stand as a reproach to American enterprise and capital.

But it is to be hoped that now the work in New York has been carried so far some way to interest capital will be found. The tunnel scheme was a last resort, to be sure; but what other plan could have been advanced? In New York not only are the streets covered with tracks, but the air above them is filled as well. There was no other choice of a means of relief. The people want no more elevated railway structures; on the surface roads high speed is out of the question; the tunnel is undoubtedly the solution. Every effort, then, to excite the interest of capital should be made, and the project should not be abandoned until no stone has been left unturned.

An Ideal Central Power Station.

After the reading by Mr. Field of the paper written by himself, E. J. Cook and F. Bourne on "An Ideal Central Power Station," at the Chicago Electric club on December 19th, the following interesting discussion ensued:

F. KING: I should like to ask Mr. Field how he could cut out any boiler or any engine in the event of the cross-over pipe breaking down. Would it not be a good plan to multiple-arc the boilers and engines as well as the pipes?

MR. FIELD: In piping large power stations I have always done that.

MR. KING: I notice in the specifications for dynamo floors that wood is used. I suggest iron floors instead; they are much easier to keep clean.

MR. FIELD: Yes, in a lighting station, but not in a railway station; with five or six hundred volts it would not be quite so nice.

MR. KING: There is no mention made in the specifications for the engines of any gearing to turn an engine while being overhauled. I have an arrangement of that kind. There are no governor disks, there are no eccentrics, and the whole engine is brought to a very small space. Suppose you have a 1,200 horse power engine, occupying three and a half feet floor space per horse-power. In the starting valves of these large engines there is very often a back lash. The spindle in the starting valve—in the main throttle valve, as you might call it—is made of composition metal, and very often wear occurs. I have often noticed in the starting valve of an engine of that kind that it took nine turns of the hand-wheel to open the valve wide, and when the engine gets a hot crank pin, and you have to run about twenty feet to get to the valve and shut it down quick, it consumes considerable time. It might be a good plan to combine with a starting valve of that description a lever action by which with one motion of the hand you could close it.

MR. FIELD: That has its disadvantages. If you should be made the unfortunate victim of an engine that had bearings of such a character that you could not shut it quick enough to keep from burning out the bearings, I think you would conclude that with proper bearing arrangements and an ordinary valve to shut reasonably quick, that it would fully meet the commercial requirements. In regard to turning over, I think a three crank engine can be turned over for all necessary requirements without any difficulty if you have a fly wheel, which you should have. I don't believe an engine of that kind should be built without fly wheels.

W. B. PEARSON: I would like to ask Mr. King what pressure per square inch he provides for in the bearings.

MR. KING: In one of the engines we are having built the bearings are designed for 70 pounds per square inch.

ALEX. DOW: In regard to the heavy strains on the marine type of engine, I would like to say that I do not think there is much to be feared in that line, providing the practice on shore follows in a general way the marine practice. I was at one time on shipboard and I spent a great deal of my time in the engine room, and we had very severe weather for three days; part of the time the stern of the vessel was out of the water, which of course threw the load off the engine, and then again she was laboring hard; but there was no difficulty with the bearings; we didn't have a hot box. I think if we follow the lines of practice that have been developed in marine work there will be little danger from jars and shocks due to short circuits. I believe that an engine that will stand the pitching of a 4,000 ton ship having the load thrown off suddenly by having the screw get out of water, will stand almost anything.

MR. FIELD: It has been shown by manufacturers of engines for this class of work, and also by the builders of the marine type of engines, that it was safer and far more preferable; but the engines that are required to do this class of work should have larger bearings and less weight on those bearings, and they require less velocity than many of the best type of marine engines in use at the present time.

MR. DOW: So much the better. The best is none too good. I wish to ask whether a triple expansion engine, with a governor controlling the valve—a high pressure engine—will govern properly on the load being suddenly thrown off? Will there not be enough steam in the clearance space and receivers to cause it to increase in speed? I notice that provision is made for the lead to cut off, but would it govern close enough? I am observing at present three single compound engines, and they don't govern as closely as I should wish under those conditions, and the trouble appears to arise from the fact that the receiver capacity is very large.

MR. FIELD: The receiver capacity must be too large, the fly wheel capacity not enough, and the governor a poor one.

MR. DOW: I am inclined to think that there is something in that. I have seen experiments both ways, and I am a little prejudiced in favor of governing, at least unless you have three valves.

MR. FIELD: That has been tried. We have had engines built so that the governor could be thrown by a link and connected to the first two cylinders. We found that with a triple expansion engine, with the question of lead looked after, with ample fly wheel capacity, and with a good governor that you can better take care of it on the first cylinder.

MR. DOW: Now the question comes up, does such an engine, governing only on the high pressure, divide the load equally among the cylinders?

MR. FIELD: Yes. You can adjust such an engine if you pay attention for a short time to the variations of load, where you are provided with four valves, by adjusting the valves for the intermediate and low pressure cylinders, so that you can fully take care of that and very evenly equalize the load.

MR. DOW: I would like to know the detail of your stack.

MR. FIELD: That stack is made of fire brick part of the way up, red brick the rest of the way, with iron on the outside, and when properly painted will last as well as a brick stack and will withstand all gales; it does not need any guying whatever, and will cost a proportionate amount less, and on ground where piling is necessary is an advantage.

MR. DOW: Does Mr. Field consider that the water tube boiler is more economical than the common tubular boiler, provided that the common tubular boiler is properly set?

MR. FIELD: No, sir.

MR DOW: My experience has been that the failure of economy in tubular boilers was due not to any particular fault of the boiler, but was due to poor setting. Not once in half a dozen times is a boiler set with any regard to the fuel that is to be used. We have had some experience in Chicago lately with the marine boiler in making smoke, and the marine boiler has had a very black eye.

MR. FIELD: I have installed some of the marine boilers in a town where we use common coal or screenings, and we are in a neighborhood surrounded with residences, and by putting on a stoker we have done away with the smoke nuisance. I think the smoke problem lies in the coal and not in the boiler. I think any boiler with proper coal will give you smokeless gas out of your stack if you have a good stack. With poor coal you have to resort to stokers or something that will give you perfect combustion.

MR. DOW: The question seems to be in Chicago to obtain something that will burn Illinois or common Indiana steam coal smokelessly, and the marine boiler is at present rather in disrepute in this particular line.

MR. FIELD: I presume that is because it has been used on tugs and vessels on the river, where they haven't sufficient stack capacity.

MR. DOW: In regard to valves, a good arrangement for quick handling is to put a heavy hand wheel on the valve and give it a spin and let the momentum of the wheel shut the valve while the man runs to another valve. That works very well.

M. J. SULLIVAN: I noticed that Mr. Field refers in this paper to the grounding of the return wire. We had an inquiry the other day with regard to some trouble that developed at Cambridge by the return current mining the water pipes or gas pipes in the form of electrolysis, and there was a great deal of trouble occasioned by it. I would like to ask Mr. Field if he has had that problem presented to him yet.

MR. FIELD: Yes; that problem has arisen, and in our practice it has been customary to put the positive side of our line overhead and the negative to the ground, or, where local conditions required it, to reverse that order.

MR. SULLIVAN: Do you think that would be a remedy in every case?

MR. FIELD: I can't say that it would be a remedy in every case. It has been a remedy in every case that has come to my attention. It is a problem that is being generally discussed in the East, and is worrying many central stations. Many of them have reversed their lines and found that they have remedied the trouble.

MR. SULLIVAN: Another point: You assume in your calculations a station of a certain number of horse power, 6,000, or something of that kind. In most street railway stations the capacity required at first is comparatively small. Has any rule been adopted for a calculation of the percentage of increase within a certain period?

MR. FIELD: That has got to be governed entirely by the conditions of each case. I have not necessarily assumed that this station should of necessity have its full 6000 horse power in at first. The capacity can be increased in the future. You can erect your building with a view to future development, building it with blind arches, and duplicate the station building, knock out your arches and make it practically one building.

MR. SULLIVAN: You speak of economizing floor space in large cities by the adoption of direct connected generator and engine. Have you considered the Edison station, in New York, where they have the generators on the next floor, to give practically the same economy of floor space that you do with your arrangement?

MR. FIELD: Yes, but I think it will be generally admitted that the idea of generators on the second floor in any large station doing a large amount of business is not good engineering. I think it will be generally admitted that a station of one story is more desirable, by long odds.

MR. SULLIVAN: It would be more desirable if the question of economy of ground is not to be considered.

MR. FIELD: Considering economy and everything it is preferable.

MR. SULLIVAN: You suggest that a carbon brush be used on generators. Do you think it is a good suggestion to have it heavily coated with copper?

MR. FIELD: That is a question that I am not ready to answer fully.

MR. SULLIVAN: In the matter of switchboards, do you think it is the best policy to put all the wires back of the board? Wouldn't you think it was better to put one pole in front, and thereby avoid the possibility of short circuiting by changing the two poles?

MR. FIELD: In a railway power station the switchboard can be so arranged that you have equal pressure on the switchboard all the time, and make it practically impossible to have any short circuit. The switchboards are things that have to be laid out particularly with reference to the building, and the arrangement of it, the requirement as to number of feeders, and so on; either a wall switchboard or a gallery switchboard in some modified form.

THOS. G. GRIER: Would it not be just as well to run the steam pipes down the center of the station instead of having them along the wall?

MR. FIELD: How are you going to support them and have a traveling crane?

MR. GRIER: Support them from the ground in such a way that the traveling crane can pass over the top of it.

MR. FIELD: You can do that, but I think a heavy line of piping, under heavy pressure like that would be a very difficult thing to support in the middle of a room at a sufficient height not to be an obstruction.

MR. GRIER: Do you support your pipes from the wall or from the ground?

MR. FIELD: We support them by brackets on the wall.

MR. GRIER: When they are supported from the wall you have a direct connection from the engine to the walls of the building, which would communicate the vibrations of the engine to the piping, and from there into the building.

MR. FIELD: Not if things are laid out properly. That problem has been gone over in a good many stations. Where the engines are laid out right, and the foundations of the building properly laid, there is no trouble on that score. Where the pipes are fastened too rigidly to the wall the vibration might cause some difficulty. We do not fasten them to the wall.

C. E. SARGENT: As a rule doesn't the piping shake the engine more than the engine shakes the piping?

MR. FIELD: I don't know but it does.

MR. SARGENT: What causes the vibration in the piping? Is it the impulse of the steam going into the engine?

MR. FIELD: I think possibly it is. We have found by practice and experience that the vibration and jar can be practically removed by supporting the piping on roller blocks, or something of that kind.

MR SARGENT: I would like to ask you if you think there is any virtue in copper piping? We had a case where we had to put in a lot of copper piping at great expense, and I could not see any advantage in it.

MR. FIELD: That was in the elbows and special fittings, was it not?

MR. SARGENT. It was where a goose neck connected from the header to the engine.

MR. FIELD: The copper has to be so heavy that a good piece of wrought iron for your goose neck is just as good if you take a long enough bend. It is so heavy that the idea of the flexibility of the copper is entirely removed. It is no more flexible than the wrought iron. The idea comes from the marine practice. They have to make so many bends there that they resorted to it from necessity, perhaps.

MR. SARGENT: One reason that was given to me why the copper pipe was better was that it was not so apt to leak as the iron flanges. Is there any truth in that?

MR. FIELD: No, sir; but there is a further disadvantage. Unless you are very careful about brazing the joints, seams, and so forth of the copper, you are apt to have it open.

W. L. ABBOTT: What danger is there of vibrating the adjoining buildings in foundations such as we have in Chicago, for instance?

MR. FIELD: There is no difficulty in that direction if care is exercised in designing your building and foundations. A power station, I think, should be built within its own property lines and set back a small distance. The engine foundations and all generator foundations should be entirely detached from the foundations of the walls. Then, if the piping is given ample opportunity to move, you will have no difficulty from that. I remember one case where I was called in where that question was up in a suit, owing to trouble with the surrounding property. By rearranging the piping, relieving it from its rigid connections or attachments to the walls, and by detaching the foundations from their connections to the foundations of the walls, the difficulty was removed.

MR ABBOTT: I know one case where the piping is attached to the ceiling of the building, even with hangers and rollers, which has made great vibrations. I also know of a case where the engine foundation has been built after the plan you suggest and it has vibrated the adjoining buildings. That is one question that occurred to me in the case of power houses in the down town districts adjoining large buildings.

Mr. FIELD: All I can say is that it is difficult to answer any specific case off hand, but I will say in general that with good engineering, there should be no difficulty of that kind.

B. J. ARNOLD: Mr. Field makes one point with which I heartily agree; that is, that in the designing of power buildings the work is usually put into the hands of an architect, which is perfectly correct provided the architect works in conjunction with the designing engineer who is in charge of the power station work. For the reason, as he states, that the building is often designed and the engineer must put his machinery inside of a given space.

MR. FIELD: I would suggest in regard to room that the engineer be his own architect.

MR. ARNOLD: That is my practice, but you can't always have it that way. I would like to ask what Mr. Field means by the disconnected engine?

MR. FIELD: I mean by that an engine of which one cylinder, either during operation or in a moment's stop, can be disconnected or thrown out of service, if an accident happens to one cylinder, or if it is desirable to reduce the capacity of the engine, for some special work, at certain times of day, continuously. I do not mean by that that you have got to disconnect your crank pin and your valves and everything, but an engine which can readily, either without shutting down or in a moment's shut-down, be partially thrown out of service. It can be done by an arrangement of extra shut off valves and without disconnecting any of the crank pins at all, letting the pistons run idle.

MR. ARNOLD: It seems to me, if it could be worked out, that it would be advisable to place each engine on an independent crank and independent bearings, and, if the mechanism can be effected, so that one engine can be

operated as an independent engine. I want to say a word about the auxiliary bus bar that is running one or more generators at a higher potential than the balance of the plant is operated at. It seems to me that with the practice pursued in most stations, it would complicate the handling of the generating machinery by the operators.

MR. FIELD: It does not. It can be done very simply with a single switch attached to one leg of the generator, which switch thrown one way throws it into one bus, or throwing it the other way throws it on to the other; and the same way with the feeder switches. That arrangement in general has been found to be very satisfactory with a considerable number of feeders. You know at certain times which feeders you want on that bus, and even boys will learn to readily handle it without any difficulty.

MR. ARNOLD: Of course, if that is the case, that removes my objection. I had an idea that the overloading would be so short and so often that a man would be continually handling those switches. I thought it would be a better idea to put enough copper into those feeders to equalize the loss on the outlying lines.

MR. FIELD: They readily find in a few days that at certain times they want certain feeders on the auxiliary bus.

GEN. STILES: Mr. Field evidently contemplates burning coal at his station.

MR. FIELD: Yes.

GEN. STILES: I have an electric lighting station with a battery of four boilers, and also a plant for the manufacture of gas, which I think is one of the most complete gas plants in the state of Illinois. They are side by side. We have four ordinary tubular boilers and run those boilers with manufactured gas, and I have found that from the sale of our coke and other by-products we very nearly pay for our coal.

C. G. ARMSTRONG: Mr. Arnold has referred to something in which I have had experience, in lighting large buildings. In one case the architect reserved a space 10 by 10, and I was obliged to put my plant in there. The architect thought I would want about 300 lights, but I found that it required about 3,000, and I had to get that plant in a very small space. And I found, among other things, that he had large footings in the foundations, and I could not interfere with them. I had to set an engine on each side of a post, supporting a fourteen-story building. In that case I used I-beams and bridged over, and I found that it answered the purpose very well. In regard to the switchboard, I stated some little time ago that I wanted my connections all behind the board; and I always mentioned it in the specifications, but they were always put in front. I objected at first, but I find, for general purposes, that connections in front of the board are better. If they are put behind the board you are apt to have poorer work done. Your contractor is usually pressed for time, and he will tell you that if he can have time to get special fittings he will improve on it. One thing I would suggest in your plan is to have your switchboard entirely to one side.

MR. FIELD: In this arrangement the switchboards are elevated in such a position that they are out of the way more than they would be in the middle of the room.

MR. ARMSTRONG: In designing a plant I always try to get the switchboard as close to the commutators as possible, in order that the operator will have less distance to cover to get from his brushes to his controling instruments.

A. H. MCCLURE: I have built smokestacks of this kind in Pennsylvania, and I found them eminently satisfactory. The only suggestion I could offer that would differ from Mr. Field's plan is that the stack should be lined with fire brick near the top, as the heat is more intense there than it is farther down. In regard to the vibratory effects of engines, I know of an instance in St. Louis where a large central station plant was built in the valley, and the vibration had a decidedly bad effect. I built a plant about a half a mile farther up the same valley, in the same quality of underlying material, and by carefully isolating the engine foundations from those of the walls of the building, leaving a stratum of teoacious clay between the walls and the foundation of the engine, succeeded in preventing vibration. Mr. Armstrong suggested installing his switchboard in the center or near the commutators. This plan was adopted at one time for sixteen large generators, eight of them coming together. In this plant Mr. Vail, formerly engineer of the Edison company, and myself designed a switchboard to be placed on a table, raised above the table, and the bus bars to be parallel underneath the table, giving an uninterrupted view of everything, and it was found to be a very satisfactory arrangement.

MR. FIELD: I have put in some such an arrangement in Buffalo and one or two other places, only we put the tables in a gallery, not in a room, put them at the back of the gallery, and then put the resistance boxes in front.

MR. MCCLURE: In one case the resistance boxes came near the floor, with the bus bars above them. I know of a case of a direct coupled machine, a very large one, where there was absolutely no vibration when standing within one foot of the dynamo. It moved perfectly smoothly and quietly, and the periphery speed of the machine was about 60 feet per second. I think if care is taken with the foundation and the engine is properly installed that the direct coupled machine is infinitely superior to a belt coupled machine, particularly when we consider that by doing away with the belt we are saving from 9½ to 12 per cent. in the efficiency of a large apparatus, which makes a large item in a plant of 6,000 horse power, such as Mr. Field contemplated.

MR. FIELD: I would say in regard to direct connection work that two or three years ago we found that in large central station practice that we had got to come to it. The manufacturers in this country would not listen to anybody about a direct connection generator. I remember about five years ago I could not get them to make such a machine for me. I made a contract to put in a plant in one of the cruisers, and it was for direct connected machines, and then I went to Europe, where in some respects they are more advanced in these matters than we are, and induced the Siemens & Halske company to send a machine over here, and now the older home companies have taken up the problem.

L. A. FERGUSON: I would like to ask Mr. Field whether his plan for switch-boards is founded on theory or practice.

MR. FIELD: They are founded on practice.

L. E. MARPLE: I would like to ask Mr. Field why in his model station he has made no provision for ventilation.

MR. FIELD: There is a louver, which is the ventilator.

MR. PEARSON: One point that is of much interest to engine men and dynamo builders has not been touched upon yet and that is the question of out board bearings for dynamos or over-hung bearings.

MR. FIELD: I have provided an out-board bearing. Some manufacturers agree with that and some do not. I think the only argument that those who do not agree with it can bring against it is the question of saving a little room. Perhaps there are a few additional bearings to keep in line, but I think on due consideration of all sides of the question that the predominance of advantages is in favor of the out-board bearings. The idea of overhanging the heavy weight of one of the large type of generators, without any outside support, means that there we have to increase largely our bearings inside, and there is more liability to vibration. That I think has been shown in some of the first engines that we attempted to put up in this way without the out-board bearings. We have had no end of trouble with them.

MR KING: In the engines that we are using nowadays, that have arisen from marine practice, we find this difference between them and the engines on vessels. When the ship is started up in the water, the engine gets the load from the start; but with us on shore we have only a fraction of the load at first. The load is gradually assumed, comes to its maximum, and then falls off again toward the small hours. In that case does Mr. Field consider it safe to cut that engine out and put a smaller engine in that will be nearer its maximum load?

MR. FIELD: That depends entirely on the class of work that you are doing. In incandescent work I think when your engines get below half load there should be an arrangement for disconnection, such as I mentioned, cutting out one of the cylinders. In street railway work, we have such violent fluctuations that we would as a matter of precaution leave the engine to operate at its full capacity if the load changed.

MR. KING: I have often been asked that question, and I have invariably said it should be charged at one-third of the load.

MR. FIELD: I would say a half or a third in incandescent station work.

MR. KING: The question was raised a little while ago as to the advisability of having out-bored bearings. In the majority of engines where the armature is overhung, the bearing next to the armature is one long bearing.

MR. FIELD: I think we ought to be guided by practical experience in the question of out-bored bearings, and to get the most practical experience, I think we will have to learn what they have found in Europe. I think you will find almost universally that the out-bored bearing has proven most desirable where they have installed their machines in that way.

MR. KING: On board ships the over-hung bearings are used with good effect; and they also use double bearings.

MR. MCCLURE: The reason they do not use out-bored bearings in marine work is because it is impracticable. It is next to impossible for them to do it.

MR. DOW: If a dynamo is properly designed there is but little weight on its bearings. It ought to be partially supported by the field magnets.

MR. MCCLURE: May I ask you, Mr. Dow, about the strain from the velocity of the machine?

MR. DOW: There is very little. It really has no practical effect at all. It is a good practice to support the armature of the dynamo of the type that is being used for direct connected work a little higher than the center of the field ring, in order that the upper magnets may to a certain extent relieve the bearing of weight. It must not be so done as to affect the machine to the extent of sparking. I would like to ask Mr. Field what is the highest steam pressure that is found advisable in the triple cylinder engines.

MR. FIELD: I think in the neighborhood of 175 to 200 pounds will be found most practical.

MR. DOW: What are the objections to the high pressure system?

MR. FIELD: We have overcome all the objections so far. The objections are that you have got to have your packings, your valve seats, your valves, and those details, of different material and different composition than in a pressure up to 125 pounds. We have got to build more especially for the work. The gaskets, the joints, the flanges, and all the details of the piping have got to be designed with proper reference to it. When that is done I think 175 pounds can be operated with great ease, and a little care and attention—in fact in some cases less than a pressure of 100 or 110 pounds.

MR. DOW: Is there any trouble in cylinder lubrication in the high pressure cylinder?

MR. FIELD: No, I don't think so; not with the right kind of oils.

GEN. STILES: I have listened to this discussion with a great deal of interest. I think it would be well for the club to get some one to prepare a paper showing a smaller electric lighting station, such as we find throughout the country generally. I think it would be more applicable to our work.

MR. FIELD: I would say in regard to the question of the size of station, I have selected here to-night for the paper, that this is a size which is used in street railway work, and that for smaller stations multiples of these sizes can be used.

The Photo electric Cells.[1]

BY G. M. MINCHIN.

The cells which are employed for obtaining electro-motive force from the light of the stars and planets are known as seleno-aluminum cells. They are constructed in the following way: Take a small flat strip of aluminum about a quarter of an inch long and one-sixteenth of an inch broad; let this be heated on a clean iron plate placed over a Bunsen flame, and while it is hot let a very small bubble of melted selenium be rapidly and uniformly spread by means of a hot glass rod over about one-third of the length of the aluminum strip, the selenium forming a very thin layer.

When this layer is spread the little plate must be rapidly removed from the hot iron plate and thus cooled, while the Bunsen flame is, at the same time, removed from under the iron plate. The latter plate having become cooler, replace the aluminum strip on it, and then gradually heat up the iron plate from beneath by means of the Bunsen flame. As a result of this gradual heating, the aspect of the selenium layer on the aluminum changes; this layer changes from black to gray in appearance, and in the latter state it is sensitive to light. But to give the layer its maximum sensitiveness, several remeltings may be necessary, until a gray surface of a somewhat brownish tinge, quite devoid of glossy streaks, is produced. Nothing but an actual sight of the process of making a sensitive plate can give the reader a correct notion of the proper kind of surface. Assuming this surface produced by the gradual process of heating above referred to, the Bunsen flame is removed, and the seleno-aluminum plate is allowed to cool on the iron plate. When it has cooled (after about ten minutes) it is taken and joined to a very fine platinum wire which is inserted through a fine hole previously bored through the uncoated portion of the aluminum plate; this platinum wire is tightly pinched to the plate, so as to make a good electrical contact.

So far for the sensitive plate. The cell into which it is to be inserted is a very fine glass tube about 1½ inches long, into which a platinum wire pinched to a clean plate of aluminum has been sealed; the size of this latter plate is immaterial—it may be a mere speck of the metal at the end of the platinum wire; it is the inactive plate of the cell. In this glass tube, thus closed at one end, is inserted (by means of a pipette with a capillary stem) a quantity of pure acetone sufficient to occupy about one-quarter of the length of the tube; and then the sensitive plate is inserted until its sensitive extremity is very nearly in contact with the inactive plate, the whole of the sensitized part of the plate being covered by the acetone.

The platinum wire of the sensitive plate which now projects through the open end of the cell must be sealed into the tube, the end of the tube being, of course, completely closed by the sealing. Much practice is here necessary to prevent the vapor of the acetone from bursting the heated end of the tube; but the process becomes easy enough with practice.

The cell is now made, and if its poles are connected with those of an electrometer, and light is allowed to fall on the sensitive plate, an electromotive force will be indicated.

Shortly after the cell has been made, it is wonderfully quick in its response to changes of the incident light—almost instantaneous, in fact; but after about twenty-four hours it becomes slower in the response. The cause of this is not yet quite known; but it has been found that a constant *regime* can be produced and kept up for months by—

(*a*) Using perfectly pure acetone.
(*b*) Using perfectly pure selenium.
(*c*) Turning the cell upside down when it is not required for use, and thoroughly shaking the liquid away from the plates.

The complete and permanent elimination of sluggishness from the cell is under consideration at present.

As regards the magnitude of the electromotive forces produced, it may be said that ordinary diffused daylight falling on the sensitive plate will give an electromotive force of about ½ volt, which is surprisingly great. A candle at a distance of seven feet will give about 1 30 volt.

Light of all refraogibilities from red to violet is effective—and this fact distinguishes this cell from every other known photo-electric cell—the maximum effect being produced by the yellow rays; but there is not very much difference between the effects of the various parts of the spectrum.

By putting a number of these cells in series, the effect is multiplied by the number employed: thus ten cells in series will give ten times the electromotive force of one cell.

Hence for stellar observations the cells should be made as small as possible, and cells much smaller than the typical one above described have been made.

Does anything depend on the size of the sensitive plate? It would appear that nothing depends on the size, and that therefore a mere pin point of sensitive surface is as effective as a square centimeter. Perhaps this is so; but it has been found that the maximum electromotive force is never given when the sensitive surface is as small as a large pin head. For stellar observations this is most unfortunate; but it is highly probable that the result is due to the large size and capacity of the electrometers at present at our disposal. There is good reason to think that, with an extremely small electrometer, the pin-head plates will give as good results as the larger ones. Certainly with a common quadrant electrometer a sensitive surface six millimeters long and two millimeters wide gives as good a result as surface ten times as large. For the light of the moon

[1] Astronomy and Astro-physics.

there is no difficulty in making batteries of photo-cells containing ten or twenty cells.

With Mr. Monck's refracting telescope, the image of Mars would take, perhaps, three cells, and an unmistakable electromotive force should be produced. Jupiter would take more; but it would be difficult to cover completely the sensitive surfaces of two cells with the light of Vega. (The whole of the sensitive surface of every kind of photo-cell must be covered by the incident light to obtain the full effect.)

The best existing form of electrometer is Clifton's form of Thomson's quadrant Some very slight improvements in this instrument would render it fairly fit for photo-electric observations in an observatory. When working well (well insulated and preserved from draughts of air) it will give about 200 half millimeters deflection on a scale distant one meter from the mirror for one volt. Hence a candle at seven feet from one photo-cell has been found to give about seven divisions deflection Thus it is very easy to get results from moonlight; and with a clear sky and the absence of air currents, the light of a planet should be easily measurable.

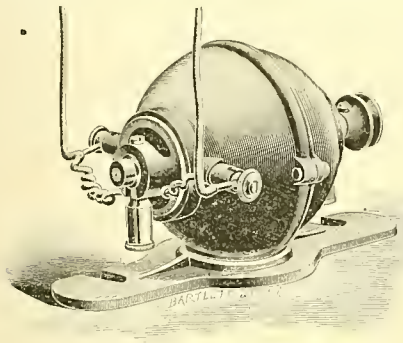
For a given source of light, the electromotive force developed in a photo cell varies inversely as the distance of the light from the cell.

Instead of an electrometer, a high resistance reflecting galvanometer could be used with photo-cells; but the former instrument is far preferable, because it is not advisable to allow currents to circulate in the cell. A galvanometer and a condenser (the latter charged by the cell while light falls on it, and then suddenly discharged through the galvanometer) give enormous deflections with moonlight; but this method is objectionable.

So far as is known at present, these cells will stand any amount of exposure to light without deterioration, provided that they are always employed with an electrometer, *i. e.*, open circuited.

Mr. Monck and Professor Dixon have, I believe, succeeded in obtaining results from the light of Mars under most unfavorable atmospheric conditions. I remained in Dublin for a week in the beginning of August to try the cells with the stars; but during this time not a single opportunity occurred, the sky being heavily clouded every night.

When a photo-battery has been used with a strong light, such as that of the moon, the deflection on the electrometer scale takes some time to disappear when the



LUNDELL MOTORS FOR LIGHT WORK.

light has been shut off. This deflection can, however, be very quickly got rid of without injury to the battery by an instantaneous connection of the battery with a Daniell cell whose zinc pole is for the moment connected with the sensitive pole of the battery, the copper being connected with the insensitive pole and with earth.

Electric Railway Securities.

It is impossible for one not making a close study of the subject to appreciate the rapid growth of electric railways, and the prosperity which, in very many cases, is attending the operating of such systems. As an instance of what is being done in this line, says the *United States Investor* of Boston, our attention has recently been arrested by the announcement that the electric line from Worcester to Spencer, Mass , a distance of 14 miles, has proved such a success that extensions will be made to Southbridge and other places. The line from Natick, Mass., to Framingham will be extended to Ashland, and eventually to Wellesley. We mention these facts simply to show how rapidly the country roads are being utilized by electric railways. It is predicted that in time, and possibly at no very remote day, the populous portions of the country will be simply a network of such lines. It is also predicted that in time the right will be granted to electric street railways to carry light freight. A move of this character, it can readily be perceived, would insure a very large increase in revenue to such roads, whatever might be the consequence to the steam lines.

This latter consideration is of more than little importance. It will not be very long, probably, before electrical communication between Boston and Worcester will be had by means of a number of connecting lines Such a fact might be of some consequence to the Boston and Albany railroad were the electric roads allowed to transport light freight. Existing roads in the different large cities of the country have so far, as a rule, showed very handsome profits, and experience is demonstrating that in the more rural districts, electric lines can also be run very advantageously. Investors should be careful how they place their money in such schemes, but where proper discretion is exercised, there are undoubtedly wide spread opportunities for making safe investments.

The business men of Brattleboro, Vt., are forming a stock company to build an electric street railway.

Lundell Motors for Light Work.

In response to a demand for a small slow speed motor which is adapted for sewing machines, and light work of that character, the Interior Conduit & Insulation company has brought out a small slow speed Lundell motor, for 110 and four volt circuits, which is illustrated herewith. These motors possess unusually slow speed, 1,200 revolutions per minute, and their efficiency and torque are said to be remarkable for motors of their size and capacity. They are mounted firmly on a base that may be secured to the floor or any substantial support, and the screw slots in the base provide a ready means for quickly tightening the belt. The little machines are noiseless, are fitted with self-oiling and self-aligning bearings and are neatly finished in black japanning with red and gold striping. These new motors complete the line of Lundell motors recently placed upon the market by the Interior Conduit & Insulation company, from 1-16 to 5 horse power capacity..

CORRESPONDENCE.

New York Notes.

NEW YORK, December 31.—As was prophesied would be the case, the Rapid Transit auction was not a success, at least in so far as the placing of the franchise was concerned. According to schedule, on Thursday, December 29th, the franchise was offered for sale at noon in the rotunda of the city hall, but although what was reported to be a bid and an alternate bid were made for the franchise, nothing further was accomplished. The bid proposed to give $500 cash, and one-half of 1 per cent. yearly of the gross receipts for the full term of the lease of 999 years. The alternate bid was submitted when the commissioners expressed a doubt as to their authority under the terms of the sale to accept a bid involving the payment of a percentage of receipts. It was for $1,000 cash. W. Nowland Amory stood as the figurehead in both instances. At the close of the public proceeding no other bids were made, the commissioners retired and remained in session for an hour or more, when they announced to Mr. Amory their rejection of the $1,000 bid.

Later the commission, through its president, made a statement in which the purpose was announced to abandon for the present the underground scheme and to devise a plan of rapid transit by elevated structures.

Substantial railroads and money interests were represented at the sale, which attracted to the city hall enough people to fill the rotunda and the stairways leading to the floor above. Melville C. Smith was there, representing the Arcade railway, and Rowland R. Hazard was present in behalf of his rapid transit interests. The Traction company appeared in the person of John D. Crimmins and William C. Whitney, and municipal interests were represented by Mayor Grant, Mayor elect Gilroy and Controller Myers, and attorneys from the corporation counsel's office.

It was reported that Bidder Amory represented the Bankers' Loan & Investment company, which in turn was acting for a syndicate of Philadelphia capitalists. The report could not be verified.

It is amusing to see the metropolis, as represented by the daily papers, struggling against the "trolley octopus." But it is also very gratifying to electrical men to see the system advancing, as it were, inch by inch, and "getting there," so to speak, "just the same." During Tuesday's meeting of the board of aldermen the committee on railroads reported in favor of granting the Union Railway company permission to build connecting trolley lines in a number of streets in the Twenty-third and Twenty-fourth wards. The Union Railway company's application went through by a vote of 21 to 4.

The opening of the New Year will not be without a tinge of sadness to many of the electrical fraternity in that the last few months have been marked by the death of several prominent men. Mr. Slattery and Mr. Meeker have passed away, and to-day I have to chronicle another death—that of Aurelio Arango. It will be remembered that Mr. Arango was the treasurer and general manager of the Edison Spanish Colonial Light company. He died suddenly Thursday morning. He left his home at the usual hour, and apparently in his usual good health, and rode down town on the elevated railroad en route to the office of the company in the Edison Building, 44 Broad street. He was accompanied by a friend, A. Navarro. When the train reached the station at Rector and Church streets, Mr. Arango was suddenly stricken with illness, and almost immediately became unconscious. He was carried into the waiting room at the station, an ambulance was summoned, and the suffering man was taken to the Chambers Street Hospital. He died soon after reaching there. Death resulted from angina pectoris. Mr. Arango was a native of Santiago de Cuba, and was 60 years old. He had been a resident and business man in this city for many years, and was well known in business circles, particularly by those engaged in Cuban and Spanish-American enterprises. When the Edison Spanish Colonial Light company was organized about five years ago for the purpose of introducing the Edison electric light in Cuba, Mexico, and South and Central America, Mr. Arango was made treasurer and general manager, and held that position when he died. He was a brother of Dr. Augustine J. Arango, a well known physician of this city. He lived with his wife and family at 132 Madison avenue.

W. F. O.

New England Notes.

BOSTON, December 31.—The West End Street Railway company is very much in the public mind at present. This is nothing unusual about this greatest of Massachusetts corporations; but for the last six months there has been a lull in public comments on matters relating to street car transportation, for since the report of the Rapid Transit Commission was laid before the Legislature nothing has been done in regard to the recommendations then made; but now the matter is revived, and it looks probable that the coming session of the state Legislature will witness a fight that will deserve to rank in history with that which took place at the time the West End bill of 1887 was passed. The cloud which is destined to break in a storm of electrical warfare over the legislators was first discerned on the Cambridge horizon. It was almost insignificant to the mind of the great majority of the public, but the West End officials appreciated its true meaning at the start, and the prediction that President Whitney made then that it was nothing but an attack on the iron-clad provisions of the West End charter has proven itself to be justified by the outcomings of the past week. The first move was a petition which was brought before the Cambridge aldermen by a company calling itself the Cambridge Storage Battery Street Railway company, asking for a location in Cambridge. This was granted by the board. But here the West End stepped in and quoted a section of the law of 1887, which provides that "No location, no alteration or revocation of location of a street railway, and no authority to run cars over or use tracks of another street railway, whether surface or elevated, in the cities of Boston, Cambridge or the town of Brookline, shall hereafter be valid until approved by the Board of Railway Commissioners." The West End had this clause inserted in the act, President Whitney saying that his company could not go ahead with the large expenditures that would be necessary to consolidate the various street car systems of Boston and suburbs and substitute electricity for horses as a motive power, unless it was made reasonably certain that it would not have to suffer a series of harassing attacks of would-be rival companies and be at the mercy of the whims of subsequent Legislatures and boards of aldermen. When the West End brought this statute to the attention of the Cambridge authorities and questioned the validity of the location they had given to the storage battery people it was seen that the matter must be brought before the railroad commissioners of the state. This was done and reports of several of the hearings held by that body have appeared in this paper. At these hearings Henry D. Hyde and Prentiss Cummings, representing the West End, repeatedly stated that there was something more to the petition other than a simple attempt to get a small road running in Cambridge. They predicted that it was in the end to be a general attack upon the West End, and that the next thing that would be heard would be a petition to the Legislature asking for permission to run the storage cars over the West End tracks and thus get into Boston with a rival line. This action has come about and presages a fierce fight in Legislative halls this winter. A few days ago Woodward Emery and William S. Hall, the leading men in the Storage Battery company, filed a petition to the legislature in the secretary of state's office asking for authority to run their cars over the West End tracks. They not only want to come to Boston, but they ask that they may be permitted to use the West End tracks in the city of Cambridge and Watertown. They say that the adoption of their system and the granting of their petition will be a public benefaction, as they have no power houses, but run their cars by a battery in each car, and do away with trolleys and the use of a large amount of wires strung above the streets, and furnishing a menace to life and safety. They thus base their claim on the ground of its being a public necessity. Under the existing state laws a street railroad company with two miles of track may be authorized to use the tracks of another road in order to furnish reasonable and necessary means of transportation to the public. This is petition No. 1 and

of course the West End can be relied on to fight it to the bitter end. But there is also a second petition which has been filed with Secretary of State Olin which affects the West End. This is signed by Joseph B. Warner, Archibald M. Howe and Horatio G. Parker, and it asks that the section of the West End act of 1887 which is quoted above be repealed. If this were done it would give any street railway company having at least two miles of track leave to ask for the right to run its cars over the West End tracks and thus lay it open to an attack all along the line and keep it busy all the time fighting rivals. It is said on what is considered good authority that the real backers of this second petition are also the Storage Battery people and that this winter's session will witness a grand and united attempt to break the West End's monopoly in Boston and vicinity. What that means can be easily realized. It will furnish President Whitney with an opportunity to spend a large portion of his lately negotiated notes in litigation and will delay the progress of genuine rapid transit in Boston until this expensive contest shall be settled in one way or another. As the Legislature of last year referred to this incoming body the recommendations of the Rapid Transit Commission it will be seen that this winter will see a more than usually interesting session, and the future welfare of the business sections of Boston depends upon the action that shall be taken. The railroad commissioners, hearing that the storage battery folk had taken their case to the Legislature, decided to cease all hearings upon the matter as an act of courtesy.

But the West End is taking something beside a defensive and negative attitude in the manner of improving Boston's means of getting about. It is also on hand with a petition to the incoming Legislature for revised legislation. President Whitney has filed with the secretary of state a document asking that a portion of the act of 1887 be amended. The portion referred to reads: "No location shall be granted upon, and no tunnel shall be constructed under, Boston Common under this act." President Whitney wants this amended so that it will read simply: "No location shall be granted upon Boston Common under this act." In other words "No tunnel shall be constructed" shall be stricken out and then any corporation can ask for permission to build a tunnel, and it is expected that the West End will at once avail itself of the amended statute and ask for permission to construct a tunnel. It is a fact that while the Rapid Transit Commission was deliberating last winter on its report and the various ways and means proposed to solve the problem submitted to it, the West End, through Chief Engineer Pearson and Engineer T.C. Clark of New York, was experimenting and planning how to solve the same problem in a manner that should include a tunnel under that sacred precincts of Boston Common. Their plans at that time combined an underground with an elevated system. The latter was to start out in Roxbury and come down to the vicinity of the business portion of the city on an elevated structure, and then burrow underground, going under the whole length of the Common and come out in the vicinity of Scolley Square. From this another elevated line would run to Charlestown. It is said now that the plan is to tunnel under the Common and pass directly under the crest of Beacon Hill and the State House and come out in the section of the city near the northern and eastern railroad stations. If that is the plan now it is changed from the one that was in consideration a year ago. Should this be finally adopted and put in operation people would be able to take a car and reach the northern stations in about five minutes where now a half hour and in many cases a longer period is required. But it is safe to say that this will never be done as long as the West End charter is liable to the constant attacks of rivals.

Chief Engineer Pearson's recent paper on electrolytic action, read before the street railway convention, is now having a practical illustration in Cambridge. It shows one of the drawbacks to the single trolley system. The action of the escaping power currents is shown not upon the telegraph or telephone wires, but upon the pipes and mains of the water and gas companies. The effects have been investigated by several electrical experts and it seems a certainty that they can have been produced in no other manner than by electricity escaping from the return wires and track. Superintendent Morse of the fire alarm and police telegraph service of that city says he has been considerable trouble in the early corrosion of water pipes which he believes to be the result of electrolytic action. When he took charge of the system he found that the men were having great trouble in locating "grounds." Upon investigation he discovered that the railway currents did not have a low enough resistance path upon which to return to the power station. Accordingly he notified the West End company that its return wire was not large enough to prevent leaking. The company then began to put in overhead returns. Within the last two months numerous leaks were found in water pipes near the East Cambridge power station. Many complaints were received by the water board on this account. Investigation showed that the rapid decay and loss of the water pipes was due to electrolytic action. Galvanized iron, rustless iron and brass and lead were all tried in vain. None of them would last over three months. Still further investigation resulted in some surprising discoveries concerning the leakage. Actual tests with suitable instruments showed a difference in potential between water pipes in East Cambridge and Cambridgeport. When pipes were connected in relaying, arcs were formed, in many instances setting fire to the hemp packing used in the joints of potential. In gas pipes much the same variation was noted, a difference of potentral of from five to ten volts being frequently noticed on the same premises. The West End is now putting up a large amount of overhead return wires and it is hoped that when this work is completed the trouble will be abated. Chipstone and drain pipe have been used with some success to surround the pipes and prevent the decomposing effect of the electric current. J. C. E.

Milwaukee, Wis.

MILWAUKEE, December 31.—The board of public works is about to re open the campaign against overhead electric light and power wires. The cause of the step is a resolution of the common council asking the board if the law requiring such wires to be placed underground was being complied with. The law in question was passed by the common council on August 10, 1891. It prohibited the stringing of electric wires on poles and it compelled the removal of all electric light wires and the poles supporting them. The ordinance required the companies to begin the work of burying the wires on January 1, 1892, and to complete the work in five years. In order to get at the exact condition of the work, the board has prepared an ordinance, which will be introduced into the council, to require the various companies, within ninety days after its passage, to submit to the board maps or plans showing the location of their posts, wires, cables, etc., and to place their names upon their respective poles. After the plans or maps have been presented, it will be necessary for the companies to obtain written permits in order to make any changes in the wires as outlined in the plans on file. The proposed penalty for each violation of the ordinance is a fine of from $10 to $50. Manager E. C. Wall, of the Badger Illuminating company, is quoted as saying that his company was not only complying with the ordinance, but was burying its wires more rapidly than it is required to do so by the provisions of the law. The city has already buried a large proportion of the fire alarm and police alarm wires.

A man giving the name of Phillip Sears, of Boston, and representing himself to be an agent of the Westinghouse company, visited Racine a few days ago and made arrangements to establish an electrical manufacturing plant to cost $250,000 and to give employment to 300 men, at a point near Racine Junction. Mr. Sears left Racine shortly afterward and nothing has since been heard of him, it is said. It is also stated that some people who wrote to the Westinghouse company received a reply to the effect that the company knew no such man as Sears.

Through the courtesy of Vice-president Payne, of the Villard syndicate, the supply men of the country will be able to make an elaborate exhibition on wheels at the street railway convention next October. Mr. Payne has offered the manufacturers of electrical supplies the privilege of displaying their goods on the Milwaukee lines and of placarding them to suit themselves. Car makers, for instance, will be allowed to put cars on the tracks and run them through the streets as they may see fit. The manufacturers say that the arrangement will add greatly to the success of the meeting. The local committee of arrangements consists of H. C. Payne, G. W. Hommel, A. W. Lynn, L. T. Gibbs and G. J. Melms. The Plankinton House will probably be the headquarters of the association. The fact that the exposition building has been secured, so that the business sessions and the electrical exhibits can be held under the same roof, will make it pleasant for both the street car men and the exhibitors.

At the last meeting of the Wisconsin Electric club Prof. C. N. Harrison read a paper on "Graphics in Electrical Engineering." In the paper it was shown that the most intricate problems of electrical engineering, especially in dynamo and motor construction, have been worked out by the graphical method—problems which the higher mathematical analyses could not solve. Clerk Maxwell and S. P. Thompson, of England, were the pioneers in the successful application of graphics to investigations in electrical work. Mr. Harrison, who is a member of the club, has resigned the position of director of drawing in the public schools for the purpose of taking a two years' special course at Johns Hopkins university.

Mayor Jackson I. Case, of Racine, insists that the common council of that city shall pass upon the question of his right to hold his present position, in view of the fact that he is a stockholder in the electric railway there. The council has neglected to take action in the matter and Mayor Case declares that he will not serve unless the aldermen put themselves upon record.

Cars are now running on all the electric lines at Racine. The company has secured an option on property adjacent to its car barns and will put in a larger engine and will put on more cars next spring.

Appleton's electric cars are to be heated by electricity Supt. Kurtz has tested a new heater and it has proven satisfactory. It takes from five to eight amperes to heat a car, the temperature of which can be raised to 65 degrees in fifteen minutes it is said, with the thermometer at zero.

The application of Receiver Melms for permision to sell the Hinsey electric line has been argued before Judge Johnson and has been taken under advisement. During the argument Attorney Timlin, representing Francis E. Hinckley, of Chicago, said that he presumed that the proceeding was to make a fair and just distribution of the money among the creditors, but that Mr. Pfister was in a position to get the cream of the money, inasmuch as his claim had been proven in court. Mr. Timlin contended that the road cleared $4,785.98 during 1891. The court is to be supplied with a full statement of the condition of road, the expense of operating it and the receipts. This statement will be made by the receiver and in addition the counsel for Mr. Hinckley will be allowed to present a showing to the court. There is little doubt of an order of sale being entered.

St. John's Cathedral, which has been extensively remodeled, is to be lighted by electricity. A parishioner who does not want to have his name made public has donated $1,000 for the purpose. Rector Keogh states that the use of gas or oil in lighting the cathedral would have soon injured the fine new decorations of its interior. The cathedral is the church of the archbishop of Milwaukee, and the introduction of electricity into the building is very interesting in view of the opposition with which the new lighting system met at the hands of the Roman Catholic church authorities a few years ago.

The Villard company's temporary power house on the South Side will not be located in the Allis works, as it has been supposed, but at the Dutcher Stove works, on Kinnickinnic avenue. It is announced that work on the plant is progressing rapidly. The electrical machinery is all here and the Allis people are rushing the engines. The foundations for the engines have already been built. The Allis company will furnish the boilers as well as the engines. A temporary structure will be erected for the boilers.

The big electric clock in the tower of the Pabst block is now running. The hands of the clock are six feet in length and the dials are thirteen feet in diameter. The clock is not a striker, but its four faces can be seen for a number of blocks, and at night they are brilliantly illuminated. Forty-eight incandescent lights, of 12 candle power each, are used, one for each numeral.

A few days ago Vice-president Payne, of the Milwaukee Street Railway company, again found it necessary to appear before the Common Council committee on railroads in order to prevent the enactment of restrictive legislation concerning the operation of the street railway system. Mr. Payne disclosed more of the Villard syndicate's secrets than he did at the first meeting of the kind that he attended. He repeated the story of the trouble at the power house, etc., and then went on to say that it has been and is a very difficult matter to obtain the money necessary to make the improvements and changes which the company has undertaken. The result of the operation of the lines while under construction has not been such as to pay fair interest upon the money invested in the enterprise. On that account the company has not been able to dispose of any considerable amount of its bonds, and funds to do the work in hand has been advanced by those in interest. Mr. Payne said that nothing is so sensitive and easily frightened as capital, especially under the circumstances surrounding the Villard enterprise in Milwaukee. Adverse legislation by the Common Council, or an agitation, such as had existed for a month, looking toward restrictive legislation on the part of the city authorities, makes it impossible to secure the money necessary to execute the plans for the completion and equipment of the street railway system. Mr. Payne added that the passage of a restrictive time table ordinance, or of any ordinance that could be con-

strued as unfriendly to the Milwaukee Street Railway company, would immeasurably injure the credit of the company and make it impossible for it to make extensions during the coming year. He stated that the company is not earning enough to pay its operating expenses and the interest on its bonds, but the men who are backing the enterprise have faith in the future of Milwaukee. They have invested in the road in the expectation that within a short time after the system is completed, the business will develop to such an extent that there will be some return upon the investment. The city, Mr. Payne declared, could not afford to pursue a short-sighted policy, as it would result in a failure to build extensions to the suburbs. The lines built by the company, Mr. Payne stated, have added millions to the value of the real estate of the city. Mr. Payne submitted to the committee a list of the extentions which his company intends to build during the coming year. These are as follows: Along Farwell avenue, Bradford street and Glen avenue from North avenue to Folsom place, and thence to Lakeside park; along the Port Washington road from Green Bay avenue to Whitefish Bay, by way of Lindwurm; along Hopkins road from Burleigh street; north along Fond du Lac avenue from Twenty-seventh street to the city limits; along North avenue from Fond du Lac avenue to the St. Paul Railway company's tracks; along Clybourn street from Twenty-second street to Twenty-seventh street and from Thirty-fifth street to Calvary cemetery and the Soldiers' Home, crossing the river over a viaduct and making a new through route from the East Side to the Soldiers' Home; along National avenue extended to the fair grounds and North Greenfield; along Forest Home avenue to the depot at Layton Park; along Howell avenue to the public park and thence to the town hall in the town of Lake; Bay View line, to St. Francis and Cudahy.

At the last meeting of the Common Council Alderman Rauschenberger introduced an ordinance which provides that whenever a street car is stopped for more than four minutes, the company shall give the passengers checks good for a ride any time within the next twenty-five days. The measure is the result of the frequent stopping of the electric cars. City Attorney Krez informed the council that it had no right to revoke the franchise of the North avenue street car line, the aldermen not having made any provision in the original ordinance for the running of street cars on the line. The city attorney was requested to frame an ordinance requiring the company to run cars on the line every half hour.

While cleaning a commutator on his car, John Burnell, a motorman on the Becker line, had his arm caught in the motor and torn from its socket. The injury may prove fatal, owing to the great loss of blood. Burnell is single.

C.

PERSONAL.

Leo Daft, of Everett, Wash., the father of electric railways in the United States, was in Chicago last week.

J. W. Kirkland, with the Thomson-Houston International Electric company, New York, was in Chicago last week.

J. H. Rhotehamel, president of the Columbia Incandescent Lamp company, of St. Louis, was in Chicago last week.

George T. Schmetzel, general manager for the Smith Electric company, Butte, Mont., was in the city last week on business for his company. He reports business in his section of the country as brisk.

J. H. Dean, electrical engineer of St. Paul, is spending some time in Chicago, where it is probable that he may remain permanently. He reports that the electrical business in the Northwest is in a most flourishing condition.

NEW INCORPORATIONS.

Standard Electric company, Denver, Colo.; capital stock, $15,000; general electric business.

New Omaha Thomson-Houston Electric Light company, Omaha, Neb.; capital stock, $1,100,000.

Pruyn company, Chicago, Ill.; capital stock, $5,000,000; to construct and equip elevated railways; N. S. Pruyn, 421 Rialto, Chicago, Ill.

Uvalde Water, Ice & Electric company, Uvalde, Tex.; capital stock, $50,000; supplying electric power and light; Clark, Fuller & Gardner, Uvalde, Tex.

General Electric company, Santa Fe, N. M.; capital stock, $100,000; all or any business in any way connected with the control or application of electricity.

Ajax Fiber Insulation company, Saco, Me.; capital stock, $1,000,000; to manufacture and deal in pulp articles of all kinds for electrical use; B. Fairfield, Saco, Me.

New York & Atlanta Construction company, Jersey City, N. J.; capital stock, $10,000; to build, construct, sell and lease railways with water, steam, electric and other motor powers; R. M. Boyd, 111 Broadway, New York, N. Y.

Locust Grove Investment company, Charlottsville, Va.; capital stock, $50,000: real estate and improvements, erecting water, gas and electric works, sewerage, etc.

Worcester Traction company, Newark, N. J; capital stock, $5,000,000; to maintain and operate electric lighting, heating and other business, etc.; Frank Bergen, Elizabeth, N. J.

Day's Point Land & Improvement company, Isle of Wight, Va.; capital stock, $50,000; real estate and improvements, hotels, manufacturing, erecting electric and gas plants, etc.

Russell & Officer Electric Construction company, Denver, Colo.; capital stock, $25,000; manufacturing, buying and selling all kinds of electrical appliances and apparatus for lighting and power.

Mason Electric company, East Orange, N. J.; capital stock, $500,000; to manufacture, buy, sell and deal in electrical goods, etc.; J. E. Van Doren, Tribune Bldg., New York, N. Y.

Fraley Electric company, San Francisco, Cal.; capital stock, $1,000,000; deal in patents, machinery and appliances for generation of electricity, and other purposes; Solon Pattee, San Francisco, Cal.

Columbia & Washington Street Railway company, Columbia, Pa.; capital stock, $40,000; constructing and operating an electric railway in Lancaster county, Pa.; Wm. Hayes Grier, Columbia, Pa.

Ohio Construction company, Cleveland, O.; capital stock, $10,000; general mechanical and electrical business, wiring buildings, erection of steam and power plants, etc.; Everett, Dellenbaugh & Weed, Cleveland, O.

Denver & Westminster Railway company, Denver, Colo., capital stock, $1,000 000; to build a railroad to be operated by electricity or cable or otherwise from Denver to suburban towns in Jefferson and Boulder counties, Colo.

Moyamensing & Penrose Ferry Road Passenger Railway company, Philadelphia, Pa.; capital stock, $75,000; constructing and operating an electric railway in Philadelphia, Pa.; Peter J. Hughes, 5 Hale building, Philadelphia, Pa.

Electric Revolving Display Manufacturing company, Portsmouth, N. H.; capital stock, $5,000; to manufacture and sell electric goods and devices; especially electric revolving display stands; Geo. W. Tebbetts, 54 Devonshire street, Boston, Mass.

Hammond & East Chicago Electric Street Railway company, Hammond, Ind.; capital stock, $200,000; acquiring rights, power and franchise of Hammond Electric Railway company and Whiting, Hammond & East Chicago Street Railway company; Chas. F. Griffin, Hammond, Ind.

Phœnix Electric company New York, N. Y. (incorporated in West Virginia;) capital stock, $300,000; general manufacturing, buying, selling, operating, leasing and acquiring electrical apparatus of all kinds and all things pertaining thereto; Goodrich, Deadly & Goodrich, 59 Wall street, New York, N. Y.

ELECTRIC LIGHTING.

The city of Paris, Tenn., may possibly erect an electric light plant.

Arrangements have been made to put in an electric light plant at Loveland, Colo.

Onalaska, Wis., is considering the question of going $30,000 in debt for electric lights.

An electric light plant is to be operated in connection with the Niagara Falls, N. Y., gas works.

The Thomson-Houston company proposes to put in an electric light plant at Menasha, Wis, to cost $25,000.

The city council of Hillsboro, Ill., has granted a franchise to a company to operate an electric lighting plant.

The General Electric company has been awarded the contract to install an electric light plant at Hannibal, Mo., at a cost of $70,000.

The Montclaire, Colo, Electric company has made an assignment for the benefit of its creditors. Its assets are $18,280; liabilities, $151,312.62.

The plant of the Nevada, Mo., Gas & Electric Light company has been purchased on mortgage foreclosure by the Missouri Trust company for $5,000.

The city of Holland, Mich., has been enjoined from erecting an electric light plant, and the question is again to be submitted to the voters at the spring election.

The Henderson, N. C., Light & Power company has been purchased by J. M. Valentine and others, of Richmond, who will improve the plant by adding new machinery.

The Electric Light, Power & Heat company of Laurel, Md., has been organized with William E. Gilbert, president; J. H. S. Compton, vice-president; J. S. Flannery, secretary and treasurer, and L. A. Ellis, manager.

An application has been filed for the dissolution of the Edison Light & Power company of Minneapolis. The total number of shares issued and now outstanding is 4,895 at $50 each. The property and assets consist of real estate and building thereon and the electrical plant. The total indebtedness is $200,000. The petitioners and shareholders are: Northwest General Electric company, 3,899 shares; H. M. Byllesby, general manager, 980 shares; Howard C. Lewis, [illegible] H. [illegible]ey, [illegible] Akely, one share each.

ELECTRIC RAILWAYS.

The Suburban & West End Electric Railway company, of Savannah, Ga., has completed arrangements to construct an electric railway.

The Ashland & Catlettsburg Electric Street Railway company of Ashland, Ky., is progressing rapidly with its line, and will be running early in January.

The Natchez, Miss., Street Railway company is endeavoring to secure authority from the city to construct necessary electric equipment for operating its cars.

There is promise of another electric street railway at Norwalk, O. G. M. Kirk, a Cleveland capitalist, has projected a road from Norwalk to Fairfield, Greenwich and New London.

The Windsor Beach, Rochester & Irondequoit Bay Electric Railway company has been organized at Rochester, N. Y., with a capital of $1,000,000, to connect Rochester suburbs.

The city council of Dubuque, Ia., proposes to refund the taxes of the Eighth street electric road for 1891 if the company will extend its lines to West Dubuque. The proposition will, no doubt, be accepted by the street railway pany.

A franchise for an electric street railroad at Hagerstown, Md., has been granted to W. F. M. McCarty of Hagerstown and others, including William C. Seddon, W. H. Edmonds, R. H. Edmonds, A. H. Rutherford, and Blackwell & Murdoch, all of Baltimore. If the franchise is accepted a four-mile electric road will be built.

The two electric lines at Washington, D. C., that are being constructed on the conduit plan are progressing fairly well. The weather has not been favorable to outdoor construction, but a few days ago the rain ceased falling and both companies are now pushing the work as fast as possible. The Rocky Creek company, for whom the Love Traction company is putting in its system, has a line into the country to Chevy Chase, the place for which Senator Stewart organized a California syndicate and purchased. It is a picturesque route and the company needs a line down town, which explains the reason for a conduit system, overhead trolley wires being strictly barred. The Wheless company is putting its system down for the Washington & Arlington company, which proposes to build a bridge over the Potomac and come into town as far as the market.

A disagreement between the Citizens' Traction and the Duquesne Electric companies, Pittsburg, which threatened unpleasant results, has been amicably settled. The Duquesne Electric company has, ever since it commenced operations, been running its cars over the Citizens' Traction company's track on Frankstown avenue, between Broad street and Lincoln avenue. When the Citizens' company began tearing up the old tracks for the purpose of laying new tracks for its electric road to Wilkinsburg, the work seriously inconvenienced the Duquesne company, as the avenue was obstructed. The Duquesne company, it is stated, demanded that the Citizen's company lay switches on Frankstown avenue for its accommodation, to which the Citizens' company objected. The Duquesne company controls the right of way into Wilkinsburg, over which the Citizens' company has to pass to complete its road to that point. The Duquesne people said they would not allow the Citizens' company that privilege unless the switches were constructed, and the Duquesne company then laid switches on Shetland and Lincoln avenues, and has been using the single track for running both directions, thus avoiding Frankstown avenue altogether. The matter has since been satisfactorily adjusted, and the Citizens' company will have no trouble in getting into Wilkinsburg.

TELEGRAPH.

On January 1st the western division of the Postal Telegraph company was divided into districts. Edward J. Nally has been appointed assistant general superintendent of the western division, with headquarters at Chicago. In addition to the duties indicated by his title he will also have full supervision over the first district. H. J. Kinnucan has been appointed assistant superintendent of the first district with headquarters at Detroit, Mich. W. I. Capen has been appointed superintendent of the second district, with headquarters at Indianapolis, Ind. C. M. Baker has been appointed superintendent of the third district, with headquarters at Kansas City, Mo.

A dispatch from London states that Cecil Rhodes, premier of Cape Colony, has issued a prospectus for a company having a capital of £400,000, the shares to be allotted if £140,000 are subscribed, to build a telegraph line to Uganda. This indicates that Mr. Rhodes has failed in his proposition to Mr. Gladstone's government to take a telegraph line through Uganda to Egypt at a cost of £140,000 to £150,000. The new company would be able to send messages at 1 shilling to Egypt and 1 shilling 6 pence thence, as against 9 shillings 6 pence per word charged by the cable companies. There are 14,000 shareholders in the companies which he represents, and if each were to send him £5 or £10 he could carry it through.

MISCELLANEOUS.

Electricity will be one of the chief features of the international exhibition in Rome, Italy, in 1895–'96.

The plant of the Raton, N. M., Electric company, valued at $10,000, has been sold at public auction to Frederick Bruggerman. The new management will put in considerable machinery and enlarge the plant.

A drove of mules, with two men in charge, was being driven up Clinton avenue yesterday afternoon. They spread themselves all the way across the avenue, and the two men had a difficult time in keeping them moving, says the Albany *Journal*. Finally, as an electric car turned out of Pearl street up the avenue, the mules formed in columns of fours on the up track and again came to a halt, despite the frantic hanging of his gong by the motorman. The car halted while the men used persuasion to get the mules off the track. At length all were got off to the north of the track, and the car moved on up the avenue. Just then one of the mules, in a spirit of contrariness, backed up and was struck squarely in the rear by the moving car, the force of the collision propelling the animal into the center of the drove with a suddenness that surprised him so that he forgot to kick, and turning his head looked sadly after the disappearing car.

TRADE NEWS.

The Interior Conduit & Insulation company of New York, announces that Charles P. Geddes has been elected secretary and treasurer of the company, in place of F. A. Mason, resigned.

The Knapp Electrical Works of Chicago are meeting with much success with their Chicago carbon battery, having sold 15,000 cells per month for the last three or four months.

W. W. Marks, the popular superintendent of the Bishop Gutta Percha company of New York, was presented by the employes of the factory with a Christmas remembrance of a gold watch, chain and charm set with diamonds. The watch was inscribed with a pleasant reminder of the season. It is needless to say that Mr. Marks values his present highly and is receiving the congratulations of his many friends.

G. d'Infreville, well-known to the electrical trade as the manufacturer of the "wasteless zinc" reports business as being very brisk. Orders have been received from the Electric Secret Service company, New York; the Union Switch & Signal company, Prof. Elihu Thomson, the American Fire Alarm company, Boston; New York and New Jersey Telephone company, New York; American Telephone & Telegraph company, New York; Western Electric company, Kings county, Elevated Railroad, Brooklyn, N. Y., and a number of other concerns.

The Wilder Duplex Electric Burglar Alarm & Messenger company of New York, has been awarded the contract for furnishing the fire alarms, New York, for Cohoes, N.Y. This will be a model plant, and the company will introduce its new white alarm box which is handsomely trimmed with gold, this color being adopted in preference to red because it can be seen more easily at night. The installation will consist of 21 boxes which will take some 15 miles of wire. The company will do the entire construction work. The order was awarded this firm after thorough investigation of the many devices offered for sale.

Waterhouse, Gamble & Co., of Hartford, Conn., are sending to the trade a very neat pamphlet, entitled, "Arc Lamps for Arc or Incandescent Circuits." The book describes and illustrates the company's interchangeable arc lamp in detail. This lamp is made in two parts. The frame contains the two terminals and lower carbon holder complete in itself and suitable for any current, and the works are contained in a case made of a single casting. These works, with the exception of the cut-outs, are the same for arc and incandescent currents, so either will fit in the same frame. The lamps are designed for quick and inexpensive charges, and customers have many advantages in operating them. For instance: If one has purchased lamps for incandescent currents, and it becomes advisable to change them to arc circuits, it is only necessary to purchase the "works" which can be placed in the frame without unhanging the lamp. These lamps may also be changed from full arc to half arc, or *vice versa*, by simply removing the magnets and substituting another set which can be slipped into place in a few moments. W. T. Partridge, New York, agent of this company, reports a number of large orders for their interchangeable arc lamp, and also that the outlook for business for the new year is very encouraging.

The Bishop Gutta Percha company, New York, reports that it has finished one of the most successful years since commencing business. This is saying not a little when it is remembered that this firm was established in 1847. By close attention to the details of manufacture, this company has now a reputation which is known throughout the country as first-class. The company is at present finishing for the United States government 7,000 feet of 3 conductor and 3 miles of single-conductor submarine cable to be used in transmitting the current for the lighting of the buoys off Sandy Hook. Another order this company has under way is for three miles of underground electric light cable with 000 conductors. This cable is being made for the West End Electric company, of Philadelphia. During a visit of a representative of the WESTERN ELECTRICIAN to the factory of this concern, it was preparing for shipment the largest reel it has ever sent out. This reel carries a cable 2½ miles long to connect an island in Lake Huron with Alpena, Mich. The total weight is 13 tons. Two previous shipments of two miles each have been made to this point to make connections between two islands. The two ends will be spliced early in the spring by a man sent from the factory. Much credit for the present prominent and successful position of this company is due to its well-known and popular secretary, Henry A. Reed.

BUSINESS.

The Massachusetts Chemical company, of Boston, is pushing the sale of its insulating material, Insullac. It has testimonials from the Consolidated Street Railway company, of Grand Rapids, Mich., the West End Railway company, of Boston, and the W. S. Hill Electric company of Boston.

The Rockford, Ill., Electric Manufacturing company reports good trade all last year and anticipates a large increase in 1893. The company now has orders for two large generators for Independence, Iowa; one 25 horse power motor for the *Inter Ocean*, Chicago, making the eighth Rockford motor in this establishment; one 250 light and one 100-light dynamo to go to St. Louis, Mo.; one 200 light dynamo for the Mineral Point Lineo & Fibre company, Mineral Point, Wis., and several small dynamos and motors for various parts of the country.

Recent sales of engines by the Chicago office of the New York Safety Steam Power company have been as follows: Columbus Electric Light company, Columbus, Ohio, 100 horse power (sixteenth order); F. Miller Brewing company, Milwaukee, Wis., 30 horse power; Brevoort House, Chicago, 50 horse power (second order); Maywood & Proviso Electric Light company, Maywood, Ill., 150 horse power (third order); F. Wayne Electric company, for Metropolis, Ill., 120 horse power; Lambert & Bishop Wire Fence company, Joliet, Ill.; General Electric company, for Purington, Ill., 100 horse power; H. S. Williams, Harvard, Ill., 115 horse power; Diamond Match company, Oshkosh, Wis., 50 horse power (third order); Griffin Silver Plate company, Elgin, Ill., 35 horse power; Illinois Laundry company, Chicago, 30 horse power; Stiger & Newhall Electric company, Chicago, 100 horse power (second order); American Restaurant, Chicago, 105 horse power; Columbus Electric Light company, Columbus, Ohio, 100 horse power (seventeenth order); Western Planing Mill company, Chicago, 15 horse power; Lion Laundry, Chicago, 30 horse power; Wolff & Nollan, Chicago, 12 horse power; Elmhurst Electric Light & Power company, Elmhurst, Ill., 60 horse power; Mt. Pleasant Road Grader company, Mt. Pleasant, Iowa, 100 horse power; Northwestern Electric Light & Power company, Chicago, 50 horse power; H. Rendtorpp & Co., Chicago, 60 horse power; Maller's Building, Chicago, 65 horse power; Monarch Brewery, Chicago, 25 horse power; Washington Park club, Chicago, 50 horse power; M. Byrne, La Salle, Ill., 50 horse power; H. H. Kohlsaat, restaurant, Chicago, 10 horse power; Minneapolis Syndicate, Minneapolis, Minn., 100 horse power (fifth order); T. M. Maguire, Minneapolis, Minn., 10 horse power; E. P. Allis & Co., Milwaukee, Wis., three horse power; H. A. Thomas & Co., Niles, Mich., five horse power; Globe Garment company, Chicago, five horse power; W. R. Jeppers & Co., Chicago, 40 horse power; Kahn, Schoenburg & Co., Chicago, 10 horse power (second order); Fraser & Chalmers, Chicago, 10 horse power; Western Dredging company, Laporte, Ind., four horse power; Strauss, Ullman & Guthman, Chicago, five horse power; Cincinnati Barbed Wire Fence company, Cincinnati, Ohio, 15 horse power; F. Wayne Electric company, for Madison, Ind., six horse power; Bradley & Kelly, McNaughton, Wis., 10 horse power; Studebaker Bros., Chicago, six horse power; Security Building, Chicago, 150 horse power; Highland Electric Light company, Highland, Ill., 80 horse power; Northwestern Electric Light & Power company, Chicago, 500 horse power.

ELECTRICAL PATENTS.

Issued December 27, 1892.

488,536. Electric Annunciator. James H. Bates, Hoboken, N. J.

488,550. Electrically Repeating Signal. Stephen D. Field, Yonkers, N. Y.

488,567. Electric Annunciator. Adelvin B. Lyman, Cleveland, O.

488,579. District Signal Box. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, Chicago.

The bell striker is included in a shunt around an electro-magnet, and is provided with a notch with which a hook upon the electro-magnet armature is engaged, the bell striker being adapted to be brought against a spring to shunt out the electro-magnet, and bring the hook into position to engage with the notch.

488,585. Electric Arc Lamp. Elihu Thomson, New Britain, Conn.

A shunt magnet and a series magnet act against each other upon the same regulating lever; the ends of the cores of the magnets are curved, the core of the shunt magnet being so curved that as the lever moves on its pivot the armature of the shunt magnet carried thereby will continually approach the core, thus increasing the attractive force. The end of the series magnet core is curved so that its armature; as the lever moves on its pivot, will continually remain at a constant distance from the core, thus causing a constant attractive force.

488,611. Thermostatic Indicator and Adjuster. Emil C. C. Krogh, Monmouth, Ill.

A pin is placed with its axis in the line of travel of the temperature actuated contact of the thermostat, and a cam is provided connected with a handle and an indicator moving over a dial which is adapted when turned to cause the pin to approach or recede from the temperature actuated contact, thus varying the degree of temperature at which a signal may be given.

488,615. Electric Railway Signal. Frank P. Schlosser, Birmingham, Ala.

488,635. Incandescent Electric Lamp. Frederick H. Prentiss, New York, N. Y.

A section of the glass bulb below the metal cap is composed of easily fusible glass so that when it is desired to renew the filament, the soft section may be removed, thus separating the end of the globe carrying the metal cap from the remaining portion; the old filament may then be removed and a new filament attached to the same leading-in wires, after which the two parts of the globe may be secured together again by by a similar section of easily fusible glass.

488,636. Incandescent Lamp. Frederick H. Prentiss, New York, N. Y.

This lamp is similar to the above, the difference being that the easily fusible section is covered normally by the metal cap, which is made in two parts, one of which may be removed to gain access to the easily fusible section.

488,640. Cable. Josiah H. L. Tuck, San Francisco, Col

488,645. Push Button and Thermostat. Edward L. Ashley and Wallace H. Camp, Waterbury, Conn.

488,666. Electric Telephonic Switch and System. Thomas B. Sloper, Devizes, England.

488,687. Watchman's Time Recorder. Willard L. Bundy, Binghamton, N. Y.

488,696. Duplex Arc Lamp. Henry M. Odell, Detroit, Mich.

A shunt circuit around both lamps contains a resistance and a cut-out adapted to be held open successively by both lamps as they burn. The two pairs of carbons are connected in multiple and a cut-out is located in the circuit of the second lamp to burn, and is held open during the burning of the first lamp, and is closed when the arc of the first lamp becomes abnormal, thus throwing into action the second lamp.

488,706. Trolley Catcher. William L. Browne, Worcester, Mass.

488,708. Electrolytic Apparatus. Thomas Craney, Bay City, Mich.

488,726. Secondary Battery. Nicholas Wladimiroff, St. Petersburg, Russia.

The electrodes are circular in form and are provided with spiral grooves upon their faces which are filled with the active material; the continuous strip of active material prevents waste by the falling out of the material.

488,738. Closed Conduit for Electric Railways. Frank Mansfield, New York, N. Y.

488,740. Electrical Switch. Charles E. Pattison, Boston, Mass.

The lever carrying the switch blade is pivoted to a support adapted to move around an axis; the contact fingers are arranged around the circumference of a circle with the axis of the support as a center. The lever blade may be moved around the circumference of the circle, and may make contact with any of the contact fingers.

488,811. Trolley Wheel. Louis J. Hirt, Arlington, Mass.

The trolley wheel is cut away on its sides so that the thickness of the walls of the grooves is such that they will be entirely worn through when the wheel has been too much worn, thus giving an ocular proof that it should be removed.

488,830. Telegraph Pole. William H. Pratt, Mount Vernon, O.

488,835. Regulating Socket for Incandescent Electric Lamps. Elias E. Ries, Baltimore, Md.

A choking coil is provided in the lamp socket, one end of the coil being connected to one end of the lamp filament, the other end of the lamp filament being connected to one side of the mains; a lever is connected with the other side of the circuit and can be moved over a series of contact terminals connected successively with the turns of the choking coil, so that as the lever is moved over the contact terminals, a greater or less number of the turns of the choking coil are thrown in series with the lamp, thus varying the intensity of the light, by opposing against the electromotive force of the generator, the back electromotive force due to the inductive effect of the core upon a greater or less number of turns of the coil. The lever is mechanically connected with the lamp so that the act of twisting the lamp serves to alter its brilliancy.

488,871. Electrical Soldering Iron. Charles L. Coffin, Detroit, Mich.

The soldering iron is composed of a bar of iron around one end of which is wound the fine primary wire, the handle being placed over the primary. Around the end of the bar are wound three or four turns of coarse wire forming the secondary, the ends being cut obliquely, and the oblique faces soldered together to form the soldering point. In order to render this point of a high temperature a resistance is inserted between a portion of the soldered ends, thus reducing the cross section.

488,872. Electrically Heated Soldering Tool. Charles L. Coffin, Detroit, Mich.

488,878. Device for Raising or Lowering Electric Lamps. William Doran, Showegan, Me.

488,889. Electric Cigar Lighter. Edward T. Gutberlet and William R. Isard, St. Louis, Mo.

488,899. Non-sparking Electric Switch. Gwynne E. Painter, Baltimore, Md.

488,928. System of Electric Distribution. Charles J. Van Depoele, Lynn, Mass.; C. A. Coffin and Albert Wahl.

Four brushes are provided upon the commutator of a two-pole dynamo, one pair set at the diameter of maximum commutation and the other pair at the neutral points. Translating devices connected between the brushes bearing on the commutator at the diameter of maximum commutation will receive the full voltage of the dynamo, and if connected between a brush of each pair they will receive just half the voltage.

488,929. Electric Railway Trolley. Charles J. Van Depoele, Lynn, Mass.; C. A. Coffin and Albert Wahl.

488,930. Electric Locomotive. Charles J. Van Depoele, Lynn, Mass.; C. A. Coffin and Albert Wahl.

The motors are connected rigidly to the axles of the truck and the required flexibility of the truck to accommodate itself to the irregularities of the track and the turning of curves is provided for by making the webs of the wheels of the truck elastic. One way of accomplishing this elasticity is to interpose between the hub and the felloe of each wheel a series of radially extending helical springs, thus permitting a certain freedom of motion of the hub relatively to the felloe.

488,940. Electrical Circuit for Telegraph Apparatus. Francis W. Jones, New York, N. Y.

488,951. Regulating Socket for Incandescent Electric Lamps. Elias E. Ries, Baltimore, Md.

From the lamp socket is suspended a cylindrical iron core provided with notches in its sides adapted to engage with springs carried upon an enveloping tube secured to the lamp. Around the tube and throughout its length is wound a coil of wire which is in series with the lamp; as the lamp is moved up or down more or less of the iron core is brought within the coil of wire. When the entire core is within the coil the lamp merely glows as the back electromotive force of the coil due to the inductive effect of the core on the coil is a maximum. When the core is withdrawn to the extent of its movement the intensity of the light is a maximum.

488,971. Lamp Support. Doctor F. Oliver, Oakland, Cal.

Eugene F. Phillips, Prest. W. A. Hathaway, Treas. W. H. Sawyer, Sec'y.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

RAILWAY FEEDER AND TROLLEY WIRE,

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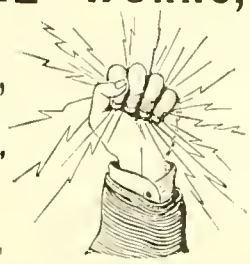
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



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A full line of choice arc specialties.

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Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

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The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

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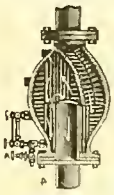

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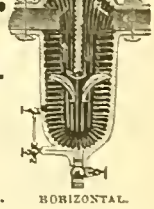

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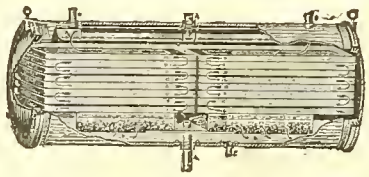

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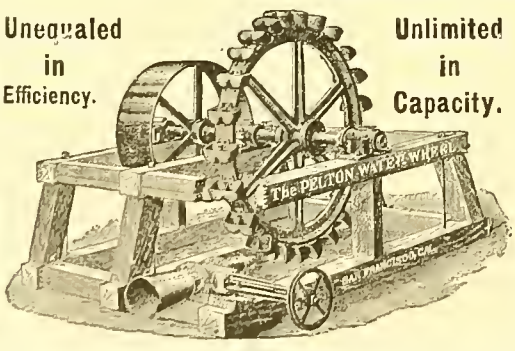

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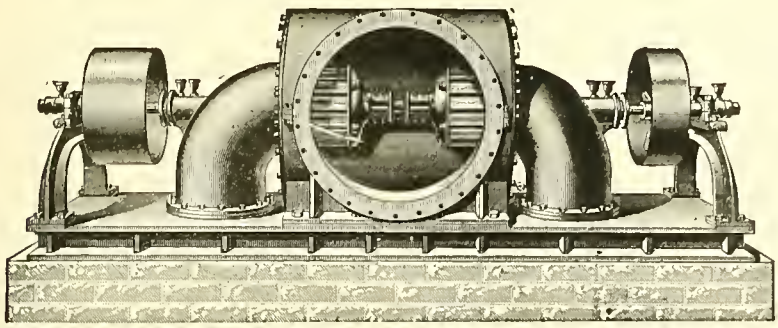

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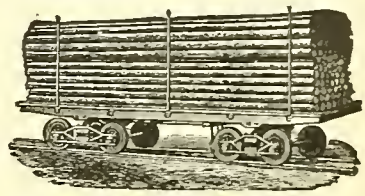

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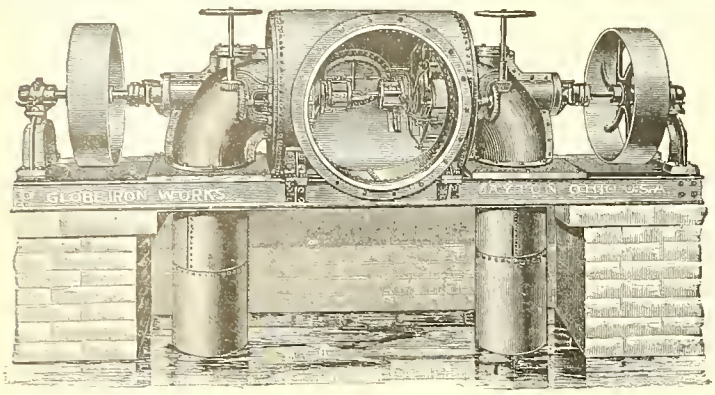

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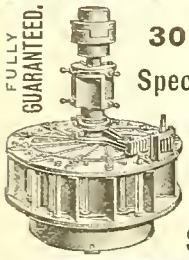

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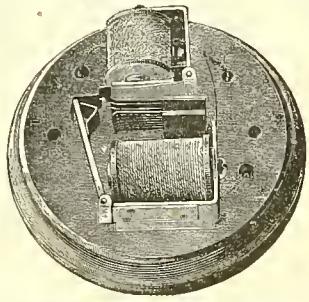

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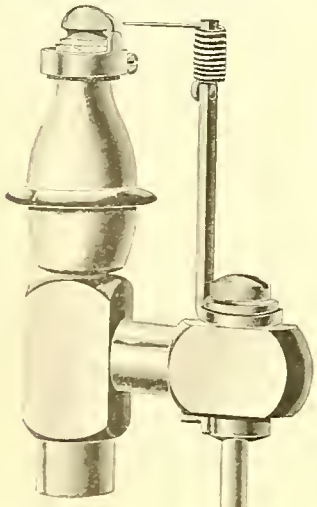

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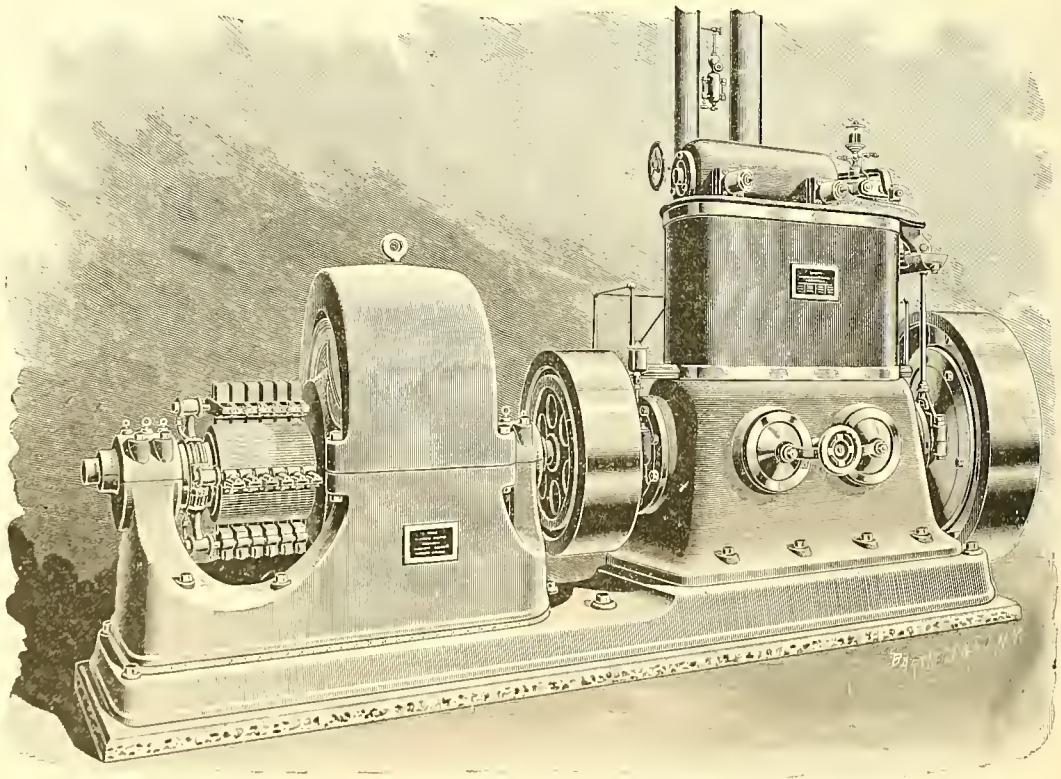

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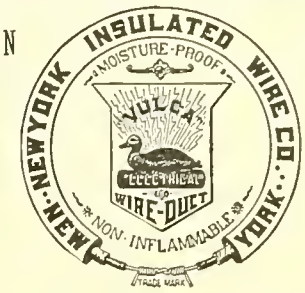

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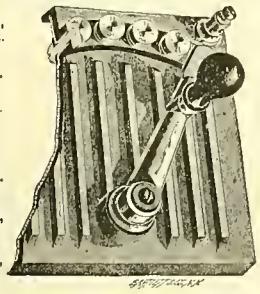

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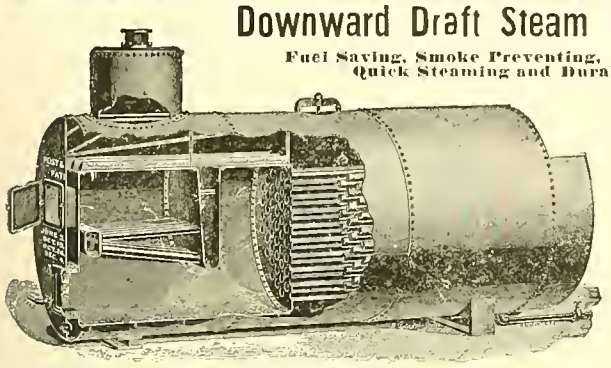

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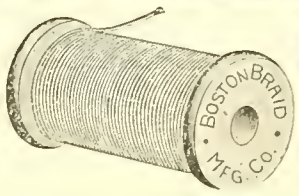

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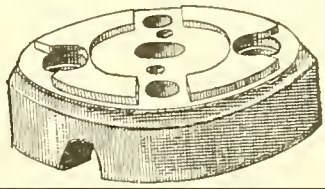

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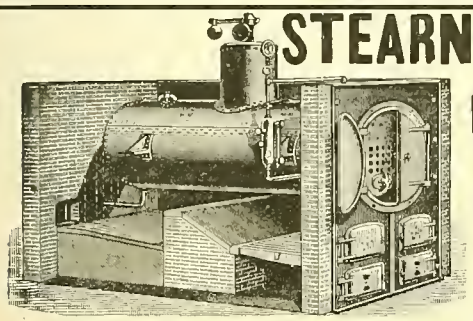

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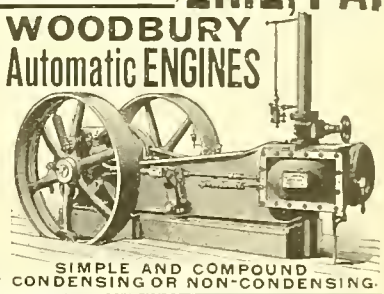

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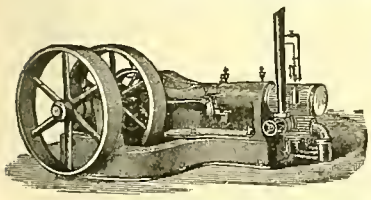

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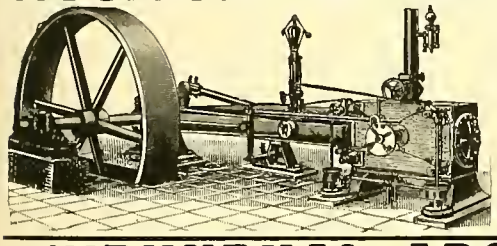

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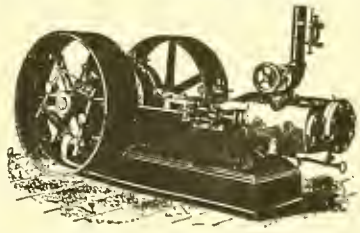

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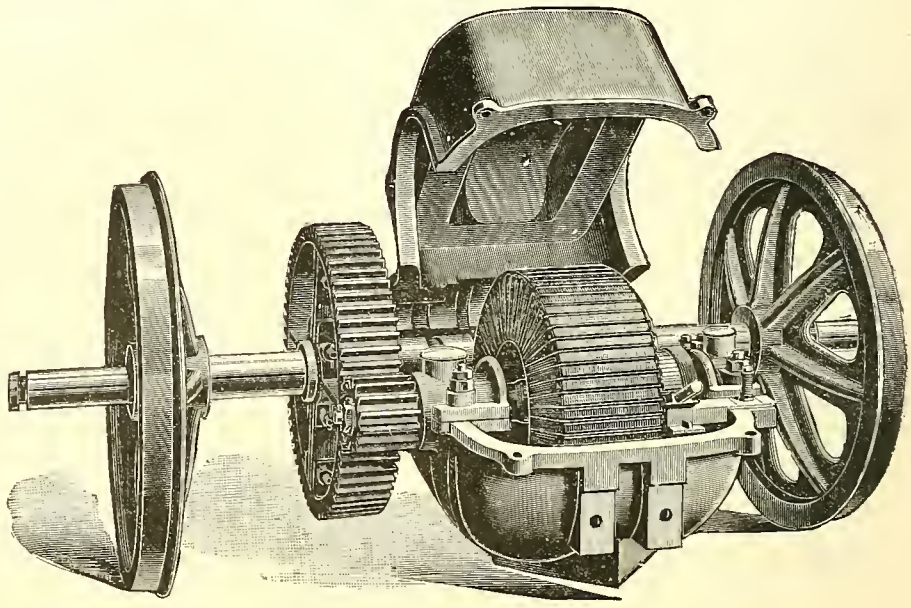

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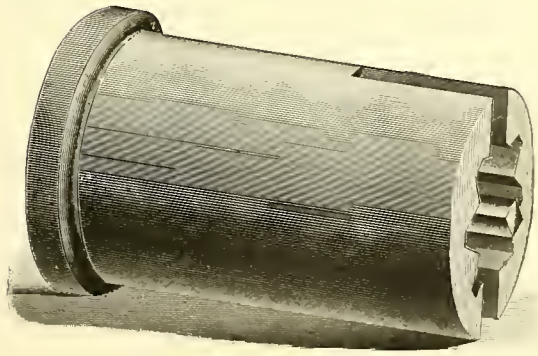

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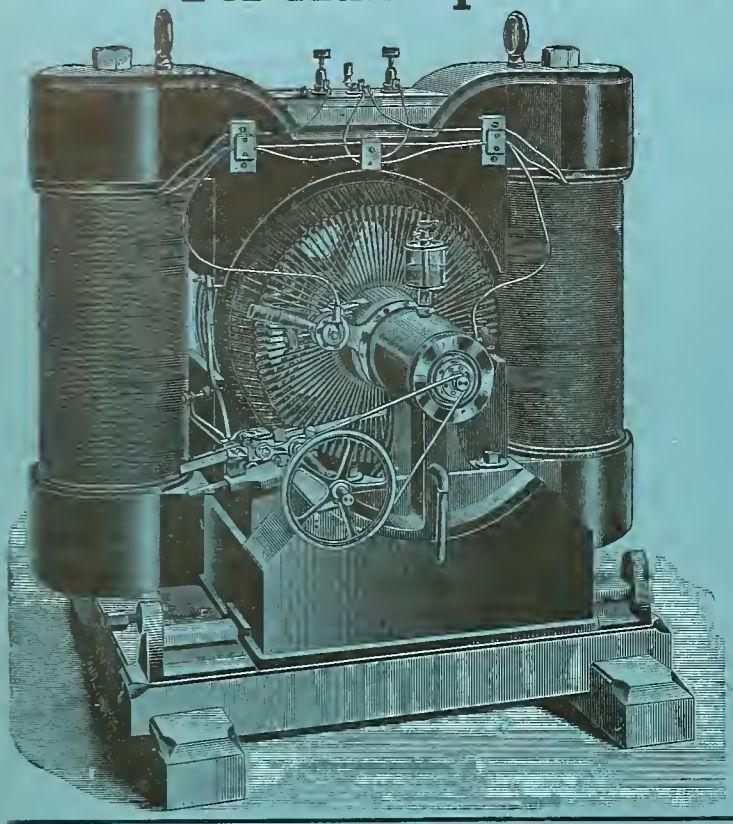

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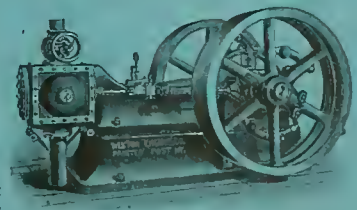

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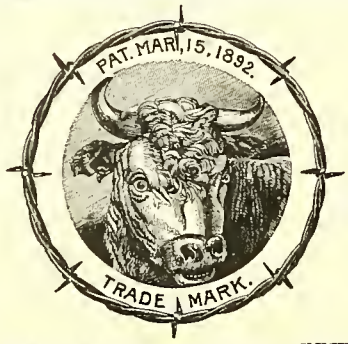

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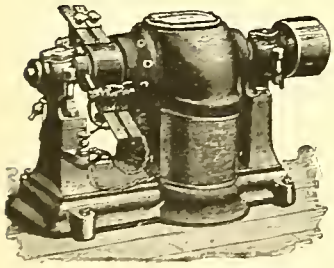

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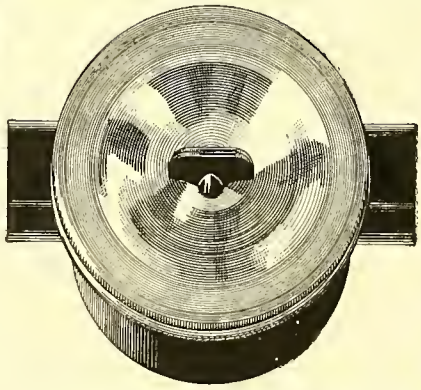

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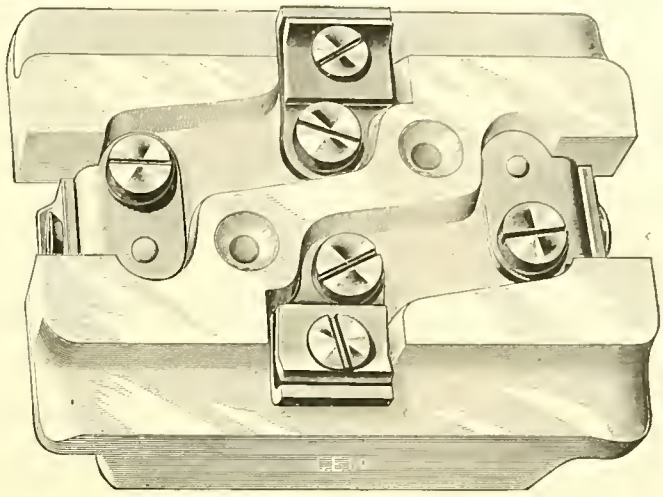

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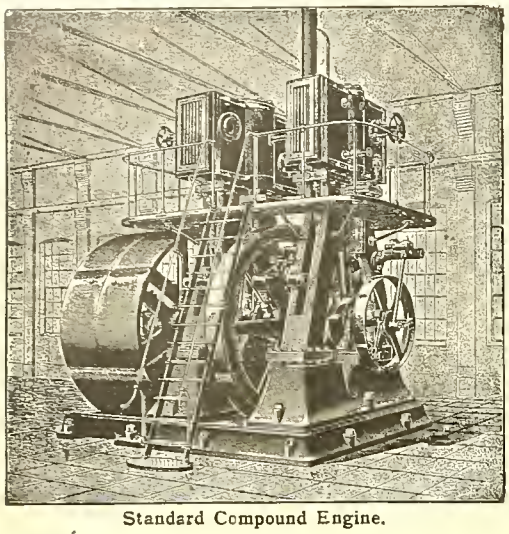

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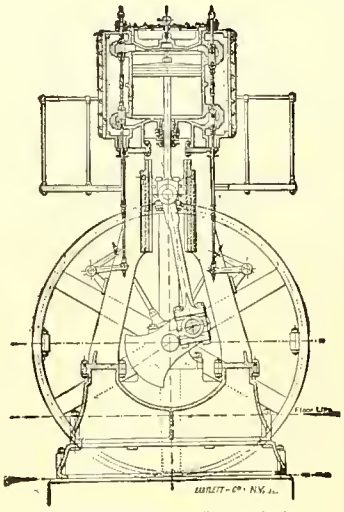

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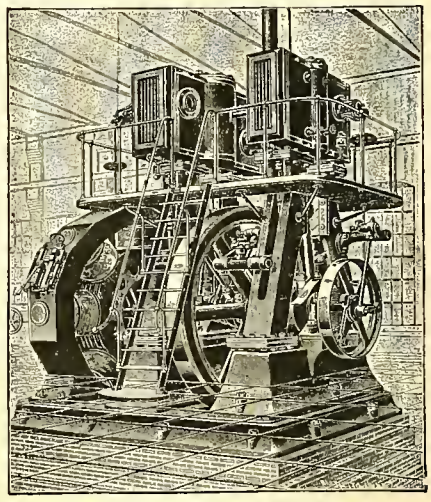

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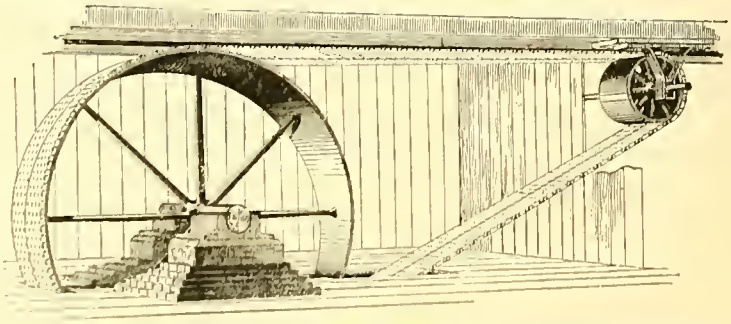

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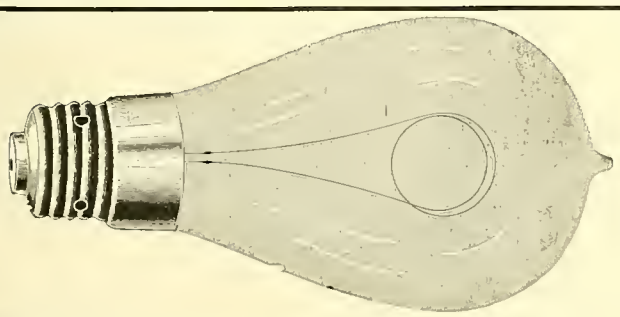

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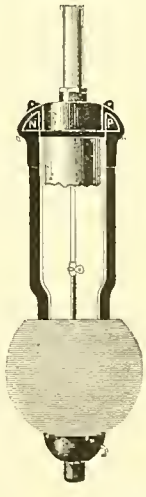

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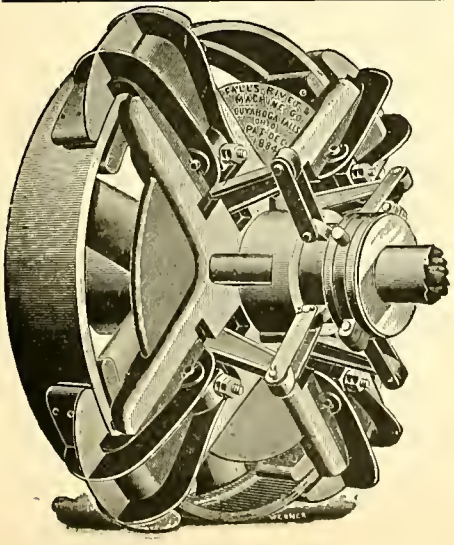

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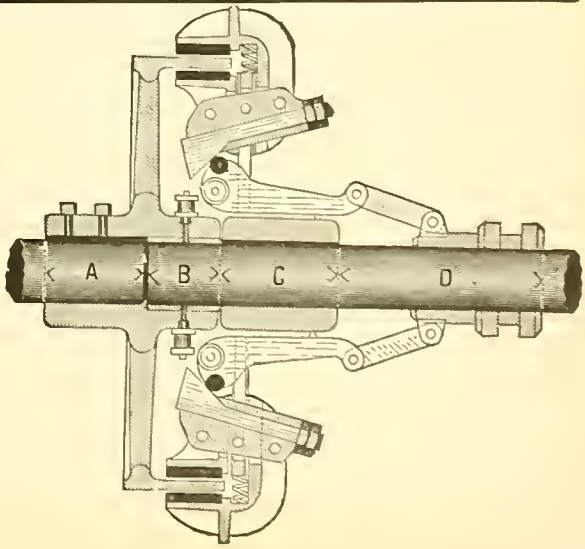

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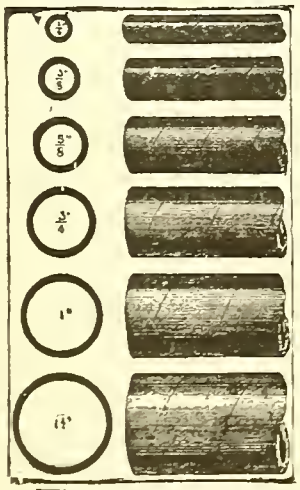

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First. The new lamps are made in separable parts so that the carbon burners may be replaced, and the glass parts used repeatedly, and their bases being moulded of uniform size to fit a specially designed socket, the lamps are neater in appearance than the all glass-globe form.

Second. The carbon burners will be preserved by an attenuated atmosphere of nitrogen, and their candle-power maintained more nearly constant than heretofore by means of a recent important discovery.

Third. Special sockets of neat design will be employed for these lamps, and special fittings will be supplied at five cents each, which will adapt any of the forms of sockets now in use to receive the new lamps, thereby bringing about exact uniformity in lamp bases.

Fourth. By reason of the manufacture of the lamps by special machinery and improved methods, by the use of nitrogen for preserving the carbons, and by means of pumping and charging apparatus recently perfected, **WE HAVE BEEN ABLE TO SO REDUCE THE COST OF MANUFACTURE AS TO FIX OUR PRICES FOR 8, 10 and 16 CANDLE POWER LAMPS AT 30 CENTS EACH, SUBJECT TO A DISCOUNT OF 10 PER CENT. TO OUR CENTRAL STATION CUSTOMERS,** and to others from 2½ per cent. upward, according to quantity, **WITH AN ALLOWANCE OF 10 CENTS FOR EVERY BURNED-OUT LAMP RETURNED UNBROKEN** to any one of our factories, making the net cost **OF RENEWALS FOR THE 8, 10 and 16 CANDLE POWER LAMPS 17 CENTS** to our central station customers. For 20 and 25 candle power lamps the prices will be 35 cents each, subject to the same discount and allowance for burned out lamps.

By long and careful tests, and by the use of a large number of these lamps in our works, we have demonstrated that the new lamp will have greater advantages for users than the Edison lamp or any of those heretofore upon the market.

The importance of the improvements in manufacture by which we have been enabled to offer these lamps at so low a price will be appreciated by all users who are aware of the constant deterioration in the carbon burners, and of the fact that the real commercial efficiency of a lamp is its average efficiency. With a constant amount of electric current the ordinary 16 candle power lamps rapidly fall below 10 candle power from deterioration of the carbon, when they must be renewed; and it results from this, that the users, with cheaper lamps will get from 15 to 20 per cent. more light from a given expenditure of electricity by a more frequent renewal of lamps than is now customary. Thus the low cost of the lamps may be made to add to the revenue of a lighting station in one of two ways, viz., either by giving a greater lighting capacity at the present cost of lamp renewals, or by actual saving in the cost of lamps with renewals made at the present period of renewal.

The problem of manufacturing a sufficient number of lamps to supply the entire demands expected from the users of electric light is a difficult one to meet quickly. We are preparing to turn out from 15,000 to 20,000 lamps daily, and in addition to this to renew the carbons in returned burned-out lamps to any extent that may be required. During the month of January we expect to be able to take care of all of our customers who must have the new lamps, and rapidly thereafter to fill all the orders with which we may be favored.

We are also contemplating the erection, as the business develops, of "renewal stations" in all large cities such as New York, Boston, Philadelphia, Chicago, Cincinnati and St. Louis, thereby reducing the cost of shipment and return of lamps for renewals, and still further reducing the net cost of the lamps to our customers.

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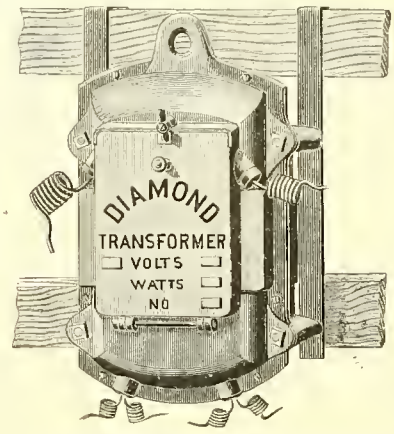

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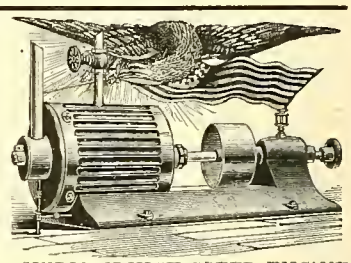

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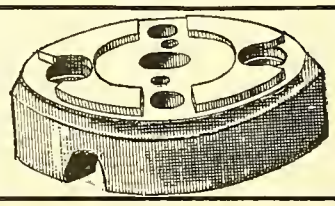

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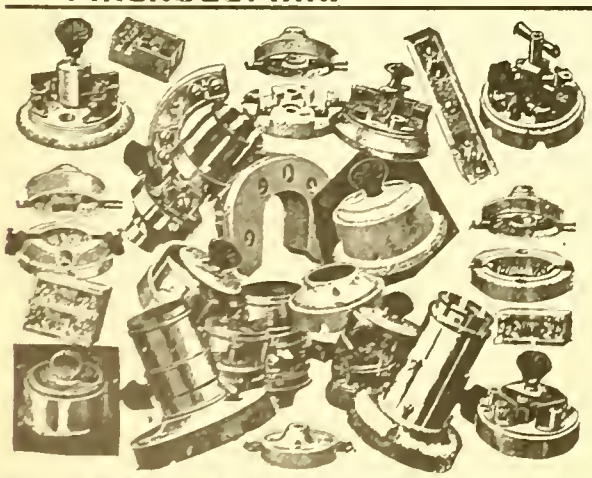

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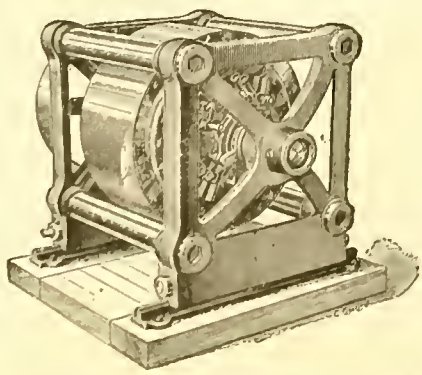

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EVERY SATURDAY.

Vol. XII. CHICAGO, JANUARY 14, 1893. No. 2

Electricity at the World's Fair.

Work on the two electric fountains at the foot of the grand basin is proceeding as fast as the weather will permit, a large force of men being employed in piling and excavating. The General Electric company, which has the contract for the fountains, has sub-let the piping to the John Davis company of Chicago, and has given the Fitz Simons & Connell company a sub-contract for building the operating casemates, which will extend seven feet below the level of the lake. The work is pushed day and night. Between these fountains is located the beautiful McMonnies fountain, which is shown in the accompanying illustration. This work of art is of especial interest to the electrical fraternity, as it is not unlikely that it may be electrically embellished, thus making three electrical fountains. Artists speak of this fountain in terms of the highest praise. The design is allegorical, representing the Progress of Columbia. The latter is shown as a young woman sitting in a handsome chair upon the barge of state, with Fame at the bow and Time at the helm. Eight female figures, personifying the arts, industries and sciences, propel the boat, while outriders are mounted on the seahorses, which plunge and rear in the waters in front. The craft in which Columbia proudly sails is not unlike the Spanish caravel. The conception is strong and the execution leaves nothing to be desired. The illustration is from a recent photograph, showing the work as yet unfinished. The outriders are not given in the picture. The electricity building is shown at the left and manufactures on the right.

ELECTRICITY AT THE WORLD'S FAIR.

J. Allan Hornsby, who has been secretary of the department of electricity since February 21, 1891, has been appointed assistant chief of the department by Director-general Davis on the recommendation of Chief Barrett. The salary attached to the position is $3,000 a year. This promotion is a recognition of the industry and zeal which Mr. Hornsby has brought to the service of the department. Prof. Barrett has been able to give but a portion of his time to the World's Fair, and nearly all of the work of the electrical department has fallen upon the secretary, acting in consultation with his chief. Mr. Hornsby has performed these exacting duties to the satisfaction of his superiors, and his promotion is the result. It is probable that another assistant to Prof. Barrett will be named before the opening of the fair. Mr. Hornsby will combine the duties of secretary and first assistant.

Wiring for the Westinghouse incandescent installation is now in progress in the manufactures, electricity, mining, machinery and agricultural buildings, and in the music hall, casino and peristyle. It is expected that some beautiful lighting effects will be obtained in the aquariums of the fisheries building, where the illumination from incandescent lamps will come to the eyes of the spectators through tanks of water, in which fish of all kinds will be swimming about.

Several of the Westinghouse 10,000 light alternators for the World's Fair are now ready for testing in the shops at Pittsburg. Some idea of the magnitude of these machines may be gained from the statement that each armature weighs twenty-one tons. The foundations in machinery hall are now ready and the work of shipping and erecting will soon be begun.

The Westinghouse company has awarded to the Standard Underground Cable company the contract for furnishing all underground cables laid in ducts that will be required for the Westinghouse circuits. This means between eighty and ninety miles of cables.

The space in the electricity building is now practically all allotted. On the ground floor there will be less than thirty exhibition spaces. Here will be shown all the heavy operating machinery sent by the principal domestic manufacturers and also many of the foreign exhibits. All dynamos will be run from motors and a limited amount of countershafting will be allowed. In the galleries will be located the lighter exhibits, a few of which will be operated by small motors. All the wire, lamp, battery, fixture, instrument and specialty displays will be up stairs. Here also will be the offices of the electrical newspapers.

The General Electric company has secured temporary quarters for its exposition staff in Chief Barrett's offices in the electricity building.

When Prof. Elisha Gray was in England, he requested the electrical section of the Royal Commission for the World's Fair to suggest a plan on which the World's Electrical Congress at Chicago could work. A committee consisting of Prof. Ayrton, S. P. Thompson and Major-general Webber was appointed for this purpose, and it has made the following report:

The committee thinks it well to prelude its recommendations by pointing out that the only international electrical congress which has met in the past under governmental appointment and auspices was the International Congress of Electricians held at Paris in 1881 under the presidency of M. Cochery, minister of posts and telegraphs. This congress was inaugurated by decrees of the French government, and the French members were appointed officially. It sat during a period of about one month; its expenses were paid under a decree of the republic dated December 6, 1880, and its objects were described as being intended to "fix" "*la langue electrique universelle.*" It consisted of one president, three vice-presidents, 234 members, 23 officials and secretaries. The delegates represented 28 governments. Although any delegate could elect to assist at any of the meetings, the representatives were divided generally into three sections, namely: First, physicists, chemists, physiologists; second, telegraphists, telephonists, and railway engineers; third, electricians and engineers occupied in industrial and civil and military applications of electricity. The meetings were classified as follows: First, full meetings of the congress; second, sectional and subsectional meetings; third, meetings at which members specially appointed read papers on specially selected subjects.

At the meetings of the first named class all subjects of first importance, including reports and recommendations from sections, were discussed, and resolutions of the congress were recorded. At the second, discussions were held on various subjects, including the careful discussion of questions arising out of the papers read at the third. At the third, to which the public by invitation was admitted there was only general discussion, most of the time being allotted to the reading of the papers.

The subjects to be dealt with at the meetings of the first named class were: (*a*) Electrical units, and the means of obtaining international uniformity; (*b*) international telegraphy and telephony; (*c*) discussion of large questions, such as the employment of electricity for lighting, electrophysiology, protection from lightning.

Of the second named class: In the first section, theoretical questions, electrical measurements, atmospheric electricity, terrestrial magnetism, lightning protectors, questions of electro-physiology; in the second section, telegraphs, telephones, batteries and generators, telegraph lines, lightning protectors, for land lines and submarine cables, induction and interruption, railway telegraph signaling; in the third section, industrial application of electricity, lighting systems of distribution, transmission of power, time signals, automatic registration, electro-metallurgy and application of electricity to chemical processes.

As regards the meetings of the third named class, events showed that papers of real scientific value were not easily secured, most writers of the first rank preferring to reserve such productions for the societies which especially deal with the respective branches of the science. Besides, it was found that in the very nature of a congress more vitality was imparted to the proceedings by the promotion of general discussion than by passing most of the time in listening to papers. For, however able they might be, they are naturally—if of real value—prepared more with a view of publicly recording the writer's views than of being merely suggestive.

The committee believes, therefore, that the subjects which it enumerates below are of special interest at the present time, and are likely to bring about a useful interchange of information and possible coincidence of opinion; but that it will require careful previous consideration as to the best way of presenting them to the congress. With this in mind, the committee has been led to refer to the work of the congress at Paris in 1881, and, in connection therewith, to recall an incident which cannot but be gratifying and productive of good feeling at a moment when the great nation then principally concerned is about to undertake a similar task in the interests to electrical science and itsapplications. It was as follows: At the meeting of the congress on September 20, 1881, if was proposed by M. Cochery, and unanimously resolved, to suspend the day's proceedings in consequence of the news of the death of President Garfield, in the following terms: "Je pense qu'en presence du deuil qui frappe une nation amie, l'assemblee voudra temoigner sa sympathie profonde en levant immediatement la seance."

Subjects on some of which it is proposed that short and suggestive special papers might be read by specially selected members.

Comparisou between procedure in different countries. Methods of avoiding electrical interference, and risks to persons and property. Units of magnetic quantities and mode of embodying them in concrete standards. The adoption of the name "Henry" for the unit of self and mutual induction. Adoption of the "kilowatt" instead of the "horse power" as the unit of power. International nomenclature for describing phenomena of alternate currents and of electro-magnetic waves. National and municipal testing laboratories. Materials for standards of electric resistance. Points of difference of the electrical vocabulary used in different countries. The direct conversion of the energy of fuel into electric energy. Comparison of the economics of the various methods employed for the electric transmission of power. The cost of insulation in relation to high pressure for the electric transmission of power. Comparison of the various systems of electric distribution. Alternate current motors. The behavior of transformers when supplying power to alternate current motors. The construction of condensers for alternate-current purposes. The measurement of power in polyphase currents. Direct coupled and non-direct coupled dynamos. The use of equalizing dynamos in a three and a five-wire system. The use of accumulators in central stations. The proportions

between output of dynamos and the weight of copper and iron employed in their construction. Electric traction. Application of electric power in mining. The adoption of a uniform method of distinguishing positive and genative mains. Electric supply meters: American, British, Continental. Criterion of sensibility of galvanometers. Commercial instruments for measurement of electric quantities. The relation between the voltage of the arc and the quality and composition of the carbons. The ageing of glow lamps. The electric working of metals. The use of electric and magnetic tests for ascertaining the mechanical properties of metals and alloys. The best material and mode of erection of lightning conductors in the light of recent researches in electric discharges. The prospecting for iron by magnetic surveys. International telegraphy. Fast-speed and long-distance telegraphy. The use of batteries or other generators for telegraphy. Telegraphic lines, land and sea. Harmonic telegraphy. Writing telegraphs. Long-distance telephony. The possibility of providing telephonic communication without wires. Application of electric signaling to the working of railways (alarms, time, etc.), and to naval and military purposes. Magnetic separators. The use of electricity in engraving and in art reproductions.

The committee suggests that it would be desirable that a selection should be made as soon as possible by the American organizers of the congress, of the actual subjects that it is proposed to deal with, so that, even before it is decided who will be requested to prepare the papers, and the order in which they will be taken, the delegates of the several nations may be made acquainted with the selected list of subjects. On receipt of that information the British committee will be prepared, if desired, to suggest names of probable anthors, and, if its snggestions be accepted, to arrange with the authors so that the papers may be ready for the congress. It suggests that a committee for the organization of the congress shall meet at Chicago immediately before the date decided on for its opening, to arrange, among other matters, for the printing of the papers in full, or in abstract if desirable, and for the preparation of the programmes of daily business.

Tronble has arisen over the boiler contract for the power plant in machinery hall. It has all come about by the claim of the Stirling company of Chicago that it has been "frozen ont" by the Exposition company. The former company claims that it was originally the lowest bidder, but that subsequently the Babcock & Wilcox and other companies offered to furnish the plant free of cost to the Exposition company, provided the boilers were regarded as exhibits. Six companies agreed to this arrangement and entered into an association for the purpose of carrying ont its provisions. They were the Campbell & Zell, Abendroth & Root, Stearns, National, Heine and Babcock & Wilcox companies. Mr. Burnham and Mr. Sargent agreed to this arrangement for the exposition. Subsequently it was discovered that an extension of the plant would be necessary, and the Stirling company sought the privilege of supplying the additional boilers. Acting on the understanding with the association, Mr. Sargent refused this request and gave the space to the Babcock & Wilcox company, which was satisfactory to the other companies in the association. The Stirling company considered this action unfair and carried the matter to the council of administration, which lately decided in its favor, despite the protests of Messrs. Burnham and Sargent, who claimed that the faith of the exposition had been pledged to the association in acceptance of its offer for exclusive service. The Babcock & Wilcox company began the work of installing the addition to the plant, and has applied for an injunction to prevent the entrance of the Stirling company. In explaining the attitude of the boiler association, its president says:

It was decided that the plant was to be equitably divided among seven boiler companies of acknowledged standing and reputation, all making different kinds of the same general type of water-tube safety boilers. The old-style tubular boilers were excluded, and only such water-tube boilers as had an established reputation were admitted to this apportionment. One of these companies withdrew under some misunderstanding of combined guarantees asked of all. The quota was then divided among the remaining six. The Stirling company had a fair opportunity for competition and was excluded because the other six companies did not wish to enter into any combination with it under the mutual guarantees expected. The contracts as finally drawn contain at least two provisions which none of the six companies would have signed except on full belief in the ability of the other five to carry out individually their parts of the agreement. Separate contracts were drawn simply because it was found that separate bonds would be necessary, but the moral obligations on the part of the six boiler companies and of the Exposition company remained the basis of these contracts. There was finally a distinct agreement that, owing to the intimate relations which must exist among the contributors to this plant, no additional power was to go into this main boiler house except with the consent of these six companies, and that they were to have the first right to furnish such additional power at the same terms as the original quota. This agreement was twice recognized in important transactions by the exposition authorities. When additional power in this boiler house was thought to be necessary the six companies agreed that the Babcock & Wilcox company

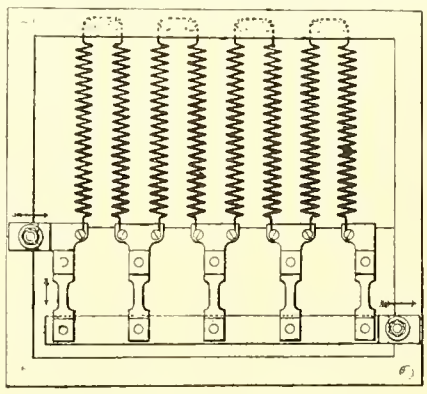


FIG. 1. CONZ' MAXIMUM CURRENT REGULATOR.

was to furnish this additional quota, since the space was immediately adjoining its exhibit. The award was made and work commenced by the Babcock & Wilcox company. The Stirling company, in now trying to have this decision changed, is not merely trying to get into the exposition, but is attempting to force itself upon six companies which have distinctly declared that they did not wish it as a member of the syndicate. The six companies should be conceded to have good grounds for their decision in this matter, which was reached early last spring and has been since adhered to. They simply insist on rights which have been guaranteed to them, and have not the slightest objection to the Exposition company putting in as many Stirling boilers as it wishes in another boiler house.

This contest has aroused considerable feeling, and there was a rumor current last week that it might lead to the resignation of Mr. Sargent, who is in New York. This is not believed, however.

It is reported that the directors, at a meeting held on Saturday of last week, adopted the commissioners' rules for the operation of the fair, including the obnoxious evening closing rule. The charges for electric light and power remain the same as published in the WESTERN ELECTRICIAN of December 17th, but at the same time the council of administration is empowered to make modifications if it be found desirable later on.

The work on the elevated electric railway is being pushed as rapidly as possible. It is estimated that trains will run over this road at the rate of twelve miles per hour, including ten stops in the run of three and a half miles. Stops will be made at the Iowa state building, Fifty-seventh, Fifty-ninth and Sixty-second street entrances, transportation building (Alley L terminal), exposition railway terminal, forestry building, and at the colonnade. The stations will be covered platforms, with stairways leading to the tracks above. Tickets will be collected at the stairways, the same as on ordinary elevated roads. An officer of the company said recently: "We will have a hard crowd to handle quickly. Many people will not know where they want to go when they start out, and will make up their minds to get off when the train is ready to start. We anticipate quite a loss of time compared with the ordinary elevated road, where people are educated to being in a hurry. We hope to be able to prove, however, that an electric elevated railway is the solution of many problems of transportation in cities." The fare will be ten cents.

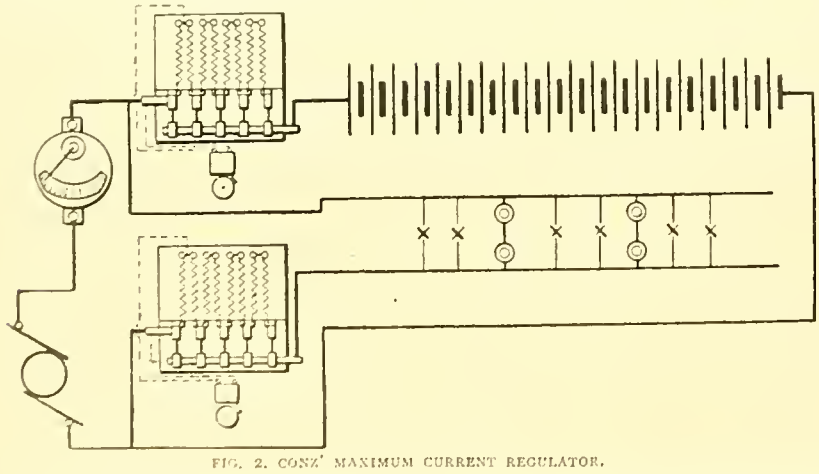


FIG. 2. CONZ' MAXIMUM CURRENT REGULATOR.

It is estimated that 75 lamp trimmers will be needed for the 5,500 arc lamps at the World's Fair. Special clusters of arc lamps will be placed at the entrances to buildings. These will be two and three light clusters, with plain opalescent globes. At each bridge approach there will be the regulation single light, while on each side of the railings in the center of the span a special post, having three lights, will be placed. Around the inclosure of the park double carbon lights will burn all night, and in the interior of the grounds every tenth light will burn from dark to dawn.

The Thomson Scientific club of Lynn recently discussed the question, "How can the Department of Electricity at the World's Columbian Exposition Best Serve the Electrical Interests?" One speaker proposed that there be a "chamber of horrors," in which the results of experiments on various unsuccessful types of apparatus would serve as a warning to prospective inventors. All the members of the club evinced the liveliest interest in the fair and expressed complete confidence in the entire success of the electrical features.

It is said that not over half the applicants for space in the machinery building can be accommodated, although it is the second largest structure on the grounds. Space for the central station plant is reserved, of course.

The work of removing the overhead wires now in use for supplying light and power for construction work will soon be begun.

The electric belt people are making strenuous efforts to secure admission to the electricity building, but Chief Barrett stands firm in his refusal. Referring to this subject, *Electricity* of New York says: 'Our wide-awake contemporary, the WESTERN ELECTRICIAN, protests against the admission of exhibits of electric belts, etc., in the electricity building at the fair. We trust that Chief Barrett will prevail in this matter, and that all quackery shall be excluded. Fakes have no more place in this building than would a Sapolio sign in a collection of fine arts."

Conz' Maximum Current Regulator.

There seems to be at present a laudable tendency to substitute for automatic cut-outs and for safety fuses in the main circuit of dynamos devices which will simply reduce the current below the dangerous maximum point, instead of breaking the circuit entirely. The latter, of course, in a lighting plant would cause absolute darkness; in a power or railway plant the absolute stoppage of all motors. There was described in a recent issue of the WESTERN ELECTRICIAN an electro-magnetic contrivance designed by F. B. Badt, which at a pre-determined maximum point would insert additional resistance in the shunt winding of a dynamo's field or in the field of an exciter. The present invention has the same object in view, but accomplishes it by different means.

The simple apparatus, Fig. 1, consists of a combination of safety fuses of equal carrying capacities and a number of resistance coils, which are arranged in a peculiar manner.

The construction will be understood after an explanation of the device's action. If the current should melt the first safety fuse it will then have to pass through resistance No. 1 and safety fuse No. 2; if safety fuse No. 2 should melt the current would have to pass through resistances No. 1 and No. 2 and safety fuse No. 3, and so on. From the fact that, through the melting of each fuse, an additional resistance is inserted in the main circuit, the voltage and hence the amperage will be reduced until a safety fuse for the maximum safe current will again carry the current.

The total resistance of all resistance coils is always calculated to reduce the current below the permissible maximum at a certain voltage. Supposing the maximum to be 100 volts and 50 amperes, the total resistance of the coils should be

$$R = \frac{E}{C} = \frac{100}{50} = 2 \text{ ohms.}$$

Fig. 2 shows the application of this safety device in connection with a storage battery. In case of short circuits in armatures or field magnets the employment of this apparatus will prevent the total destruction of the dynamos; in a lighting plant the candle power of the lamps will be simply reduced instead of being extinguished, and in a railway or other power plants the motors will continue to operate—only at lower speed instead of stopping entirely.

In case an alarm should be required it may be connected as indicated in Fig. 2. As soon as safety fuse No. 1 melts, the electric gong will ring.

An objection to Conz' apparatus that might be advanced, of course, is the fact that safety fuses of large cross-section are not reliable, and are sluggish in action.

Electric Railways for Summer Resorts.

The Rochester, Windsor Beach & Irondequoit Railway company has filed an application with the common council of Rochester, N. Y., for a franchise to construct, equip and operate electric railways between the city and the numerous summer resorts in the neighborhood. The object of the company is not to compete with the Rocheste Railway company, but to afford direct electric lines to Windsor Beach, Sea Breeze, Newport House, Glen Haven and other summer resorts.

The projected Windsor Beach line is to begin at the corner of North and Franklin streets, and pass through Chatham into Kelly, Kelly to Hanover, Hanover to Herman, to Thomas, through Hoff to Norton, through Norton in a westerly direction to North St. Paul street to Seneca Park, to Little Ridge, thence in an easterly direction to Hudson street, thence to Windsor Beach, connecting by ferry with Charlotte. The Sea Breeze line will start from the same point, and pass through the same route as the Windsor Beach line, to Norton street, along Norton in an easterly direction to Woodman road, so called, thence in a northerly direction along Woodman road to Sea Breeze. Route No. 3 is to the Newport House. It will start, from the same point through to Norton street, in an easterly direction to the Woodman road, thence along the road to the Forest House, from the Forest House, along the highway to the Newport House. Route No. 4 is to Bay View and Glen Haven. It will start from the same point through to Norton street and directly east to Bay View and Glen Haven on Irondequoit bay.

It is also proposed to establish connection at the Rifle Range with Riverside and Holy Sepulcher cemeteries to accommodate East Siders. This will result in reaching the cemeteries in half the time and with half the fare now required. It is expected that these routes will greatly increase the popularity of the resorts to which they will run. They will bring Charlotte, Windsor Beach, Rock Beach, the Sea Breeze, Newport House, Bay View and Glen Haven within a few minutes' ride of the city. Low fares will be charged. These routes are all on highways which touch farms and residences and they will bring the residents of that portion of the country within easier and quicker communication with Rochester, and thus materially help the business of the city. It will undoubtedly enhance the value of the whole territory over which the road will run.

One of the managers of the road said recently: "We do not anticipate the slightest difficulty in securing the franchise from the Common Council for the small portion of territory within the city limits. We have already secured the right of way from property owners for all the routes. Just as soon as we secure the franchise we will go ahead with the operations. It deserves the hearty encouragement of the authorities and of all citizens."

The officers of the company are: Stephen Remington, president; Charles Goetzmann, vice-president; Frank J. Hone, secretary and treasurer.

Recent Improvements in Electric Locomotives for Coal Mines.

In the accompanying cuts are shown views of a new electric locomotive recently installed in the coal mine of the old Pittsburg Coal company at Hymera, Ind. Considerable experimental work has been done at this mine and during the last year different types of electric locomotives especially designed for mine haulage, have been tried.

FIG 1. RECENT IMPROVEMENTS IN ELECTRIC LOCOMOTIVES FOR COAL MINES.

The machine illustrated herewith, which is the latest type designed for this mine, has been adopted. During the recent tests a comparison was made between this machine and one which was installed more than a year ago. The performance of these machines illustrates the improvements that have been made in this class of apparatus within the last twelve months.

The motor on the locomotive illustrated, is of the 50 kilowatt or 60 horse power, 250 volt, series wound, four pole slow speed type. The armature is connected to both axles by means of a single reduction spur gear and idler. The pinion on the armature meshes into the idler which in turn meshes into gearing bolted directly to the face of the traction wheels. These wheels are solid rolled steel, 20 inches in diameter, with 26 inch wheel base. All of the bearings are self-oiling. The starting resistances are placed under the seats at the ends of the locomotive. The starting or controlling device is a novelty, in which a short circuiting device has a reciprocating path over the face of the contacts placed on a horizontal bar in front of the motor man. It may be readily handled from either end, and is moved directly without any complication of levers, chains or wheels. A heavy shield of iron three inches thick surrounds the seats to protect the motor man from injury in case of collision or jumping the track. The locomotive is eight feet long over all, forty-five inches high from the rails and forty-three inches wide. Sand boxes are placed in front of each wheel and a powerful brake is arranged to be quickly and easily applied to both wheels. An iron hood protects the machine from the drip in the mine. The motor is geared for an average speed of five miles per hour—one of these motors on a test trip hauled thirteen loaded cars, about 26 tons, over 1,800 feet of track on which was a five per cent. grade and curve, with an average of 88 amperes at 250 volts. The highest reading showed 104 amperes.

The motor car, which these motors replaced and which had been in operation in the mine about one year, required an average of 98 amperes to propel itself over the same route without hauling any load. When hauling only ten cars or 20 tons over the route, it required an average of 175 amperes at 250 volts potential, the highest reading being 240 amperes. This motor car weighed twelve tons and had four reductions to the traction wheels from the motor shaft. It had eight wheels and a double truck, the motor was also of 50 kilowatts capacity. This test would seem to indicate the superiority of single truck, slow running motors with single reduction for coal mine haulage. The machine illustrated herewith was designed by Force Bain, of the Bain Electric Manufacturing company, Chicago.

FIG. 2. RECENT IMPROVEMENTS IN ELECTRIC LOCOMOTIVES FOR COAL MINES.

World's Electrical Congress.

Elisha Gray, chairman of the World's Electrical Congress committee, announces that there will be a meeting of the advisory council on January 17th, at the rooms of the American Institute of Electrical Engineers, 12 West Thirty-first street, New York city, at 2 P. M. This meeting is called to consider the reports of the English and American committees appointed to formulate a programme for the World's Congress of Electricians, to be held in Chicago next August, and to transact such other business as may come before the meeting. An invitation is extended to members of the local committee to attend the conference.

St. Louis Electric Club.

The St. Louis Electric club has completed its organization, and will begin the year with ninety members. The club has secured its charter, and it is the intention of the projectors to make it one of the permanent institutions of the city. Headquarters have been secured in the Equitable Building, Sixth and Locust streets, St. Louis. The rooms will be on the second floor, and they will be furnished in a manner in keeping with the character of the organization. One room has been furnished for a general lounging, reading and reception room. It is 60 by 40 feet, and is exceptionally well ventilated and lighted. It is heated by steam, and lighted with incandescent lamps. The second room will be furnished as a billiard and smoking room. The electrical men of St. Louis will have

no occasion to feel ashamed of the quarters to which they can introduce their colleagues from abroad during the convention of the National Electric Light association next month.

Single Wire, Non-Insulated Telephony.

The characteristic of the effort made by electricians in recent times to favor the extension of telephonic applications is, according to *Annales Industrielles*, a return to simple apparatus of compact construction. Some have tried to modify the receivers, and in this order of ideas we may recall the fact that the Aubry apparatus gives good results, as is also the case with the Roulez receiver constructed at the artillery shops.

As regards transmitters, the mulitiplicity of the microphones produced in recent years has, so to speak, overwhelmed the researches of electricians and prevented them from pursuing a practical and definite object, and they have been content for some time to seek perfection of regulation and strength in the apparatus.

Aside from these two important points, the great preoccupation has been the installation of aerial, subterranean or submarine telephone lines, the improvement of the processes of manufacturing the cables, the increase of their conductivity, the augmentation of the properties of the insulants, and the explanation of certain phenomena of induction, the effects of which very justly disquieted electricians in particular, and all persons in general, who, in utilizing the telephones as a mode of communication, found themselves doomed to suffer from this state of things.

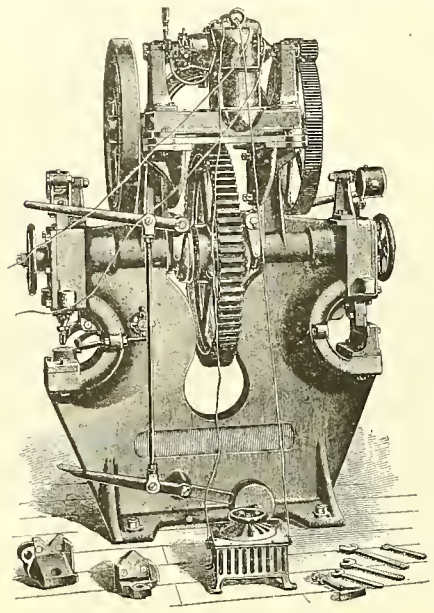
Along with these questions certain labors have been performed, that by themselves present a certain interest. Certain conditions of establishing lines have been determined that promise great surprises for the future, and great enterprises, such as that of long-distance telephony, have been brought to a successful end. In this category of studies the establishment of the Paris-London line may be regarded as an event.

But, along with the engineers who interested themselves in this idea and who solved important problems in so happy a manner, there worked other investigators, who, proceeding in an entirely different manner, reached results of just as vast a range. After the experiments of telephony without wires of Bourbouze, following the experiments on telegraphy with naked wires of Captain P. Cardew, we have now the telephonic processes of Captain Charollois. It is these latter experiments, still very recent, that are of peculiar interest.

The arrangement that Captain Charollois was studying as long ago as 1888 utilizes the peculiar properties of a special conductor—the Martin bi-metallic wire with steel core covered with copper. This wire is stronger and less oxidizable than the wires in daily use in electrical applications. It is now to be found in the market, and its relatively low price specially recommends it for hundreds of installations in which it may advantageously replace the ordinary conductor.

The characteristic of the Charollois arrangement resides essentially in the use of this wire, which, unwound naked upon wet or dry earth, or even upon grass covered with dew, or in water in which it may be submerged for a certain length, constitutes a telephone line which, ending at its two extremities in two magnetic receivers, transmits, by earth return, the induced currents circulating between these two receivers, and, at distances that are sometimes considerable, permits of exchange of conversation and acoustic signals under conditions that are eminently practical and curious; practical in the sense that these lines do not necessitate a special set of instruments, and that the installation, effected in a summary manner, is exceedingly simple; and curious in that the theories generally admitted on the subject of the propagation of currents by naked wires seem to be demolished.

The experiments of Captain Charollois relate to two applications that present more than one point in common. The principal one relates to the adaptation of this process to military operations, and the second to industrial and domestic uses.



ELECTRICALLY DRIVEN PUNCH AND SHEARS.

In the application to military operations, the Charollois arrangement, which gave excellent results in the maneuvers of the North in 1890, and of the East in 1891, includes the organization of a telephone service capable of being understood at a distance of a mile, and putting in communication the elements of an army corps by means of intermediate stations.

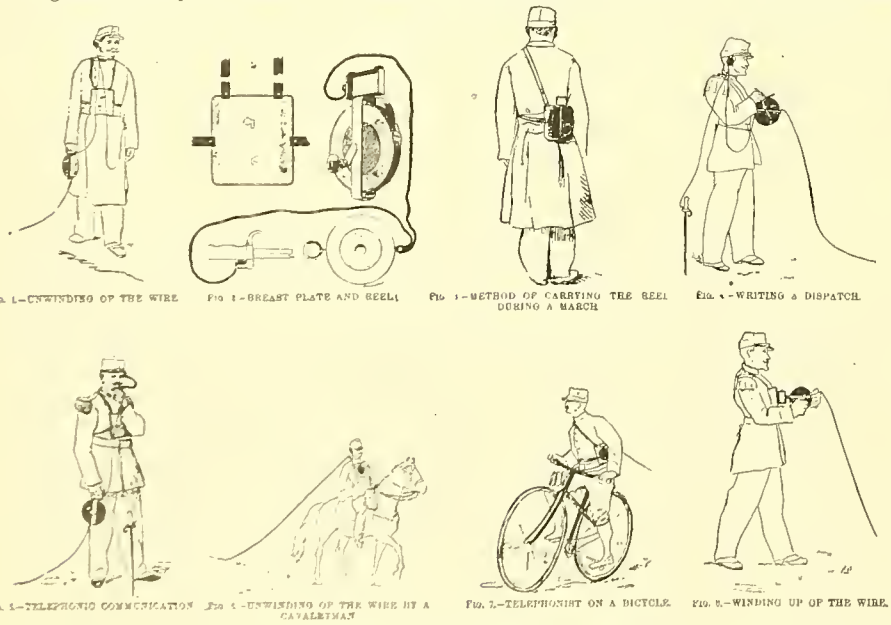


FIG. 1.—UNWINDING OF THE WIRE. FIG. 2.—BREAST PLATE AND REEL. FIG. 3.—METHOD OF CARRYING THE REEL DURING A MARCH. FIG. 4.—WRITING A DISPATCH.

FIG. 5.—TELEPHONIC COMMUNICATION. FIG. 6.—UNWINDING OF THE WIRE BY A CAVALRYMAN. FIG. 7.—TELEPHONIST ON A BICYCLE. FIG. 8.—WINDING UP OF THE WIRE.

FIGS. 1 TO 8. SINGLE WIRE, NON-INSULATED TELEPHONY.

The establishment of the line offers some peculiarities that it is well to bring into prominence. In the first place the diameter of the wire is only of secondary importance as regards results, and were it not for fear of breakage in a rapid unwinding, the finest possible bimetallic wire might be preferred. Experiment has been made with the same success with wires of 0.15, 0.02, 0.03 and 0.06 of a millimeter without a sensible diminution of the sounds furnished to the receivers.

Under ordinary circumstances the arrangement by relays weighs but little, the entire equipment being reduced to less than five and a half pounds.

The telephonists are organized in sets. Each set comprises two men. The first, Fig. 1, carries upon his ches a sort of a breast-plate held by leather straps. This plate is made of steel and is provided with two apertures for the reception of the pins of the wire bobbin. The latter, which is also represented on a large scale in the figure, is formed of a grooved pulley, upon which may be wound 10,000 feet of wire. The pulley is held by its axis between the branches of a U shaped iron, which carries at its anterior extremity and upon one of its lateral faces the pins designed to fix the bobbin at right angles, or parallel with the breast-plate. Fig. 2 clearly indicates the form and working of the plate and bobbin. Finally the pulley is connected with a winch that permits of winding up the wire when the line is taken up. Fig. 3 represents the telephonist at rest and equipped.

In the case of communication by cavalrymen, the breast-plate includes a rod terminating in a small pulley held in a fork and movable in all directions, designed to facilitate the unwinding of the wire.

In all cases the receiving and transmitting apparatus remain fixed to the strap of the "kepi," and permit of listening or talking, and of transcribing a dispatch with the greatest facility.

Figs. 4 and 5 show how this double operation is performed. When the telephonist is at a standstill, he can increase the clearness of perception by completing through his saber bayonet stuck in the earth, and connected with the second terminal of the receiver, the return to earth that is effected in principle through his body itself. So, too, when it is a question of a cavalryman, the return is constantly assured in an efficacious manner by the shoes of the horse, Fig. 6.

The line, consisting of a wire unwound upon the ground, and hooked to trees, bushes, etc., without any insulation, is laid very rapidly by foot soldiers, cavalrymen or bicyclists, Fig. 7.

Each set, comprising two men, carries the material necessary for the establishment of a one-mile line. One man attends the extremity of the line, which is connected with the line that follows, and, while the second operator remains charged with the surveillance of the line laid by his set, the other keeps himself in permanent telephonic communication with his original station and the telephonist of the set that goes before him.

Under such conditions it will be seen that the establishment of the line proceeds with great rapidity. The taking up is done still more quickly. Fig. 8 represents the telephonist performing this operation. At the last maneuvers a 14-mile line was established thus in five hours and taken up in one hour.

The passage of a division of cavalry over the wire did not, in the course of an experiment, interrupt the communication of a dispatch that was being sent at the same moment. The line attached to a captive balloon has been utilized for the exchange of orders without any difficulty.

A great advantage of the telephone system is the centralization of the orders. Thus, on the 14th of September, 1891, an order of assault, setting in motion two army corps, was received and put in execution in ten minutes.

Some recent experiments have once more verified the facts presented, and, not long since, a line of this nature that had been hastily established from the Reuilly barracks to Joinville-le-Pont, was operated accordingly with complete success. In other experiments the merits of this telephonic system have been tested upon a line installed in a few minutes on the extensive grounds of the works for raising the water of the Marne, at Saint-Maur-les-Fosses. This line, which had a total circuit of 10,000 feet was laid on the ground without any supports.

A system of call styled "dog" used in the army has been tried. This call is produced by means of an instrument devised by Mr. Sieur, and in which a wheel carrying a series of strips of steel upon its circumference and passing between the poles of a magnet develops currents of variable frequency, which, circulating in the line, produce in the receivers a characteristic signal perceptible at a distance and imitating the bark of a dog.

Electrically Driven Punch and Shears.

The applicability of electric power for driving directly machine tools is every day becoming more appreciated by manufacturing machinists. No better example of the peculiar fitness of the electric motor for this sort of work can be presented than the one illustrated herewith. This machine was made by the Hilles & Jones company of Wilmington, Del. It marks a departure in the way of driving such machines. As will be seen, the cut represents a combined punch and shears driven by an electric motor on top. This particular machine was built for a large shipyard,

and can be placed alongside of the vessel or lowered into the hold, so as to avoid the expense of moving heavy material, the cost of moving the machine, of course, amounting only to a trifle. The machine can be used as a double punch, a double shear, or a punch and shear combined. The cut is from the *American Machinist*.

An Electrolytic Disinfectant.

Mention has been made of the fact that at the time of the outbreak of cholera at Havre and Rouen the prefect of the Seine utilized electrolytic methods of disinfection to combat the epidemic. The system employed was that of Eugene Hermite, which involves the electrolysis of common salt or any of the chlorides, producing a decoloring and disinfecting solution. In the illustration is presented a view of one of the very simple installations made for the purpose of preparing the liquid disinfectant. The boiler and engine are located on the ground floor, while the dynamo and electrolytic bath are placed in the room above. Sea water, or a water in which sea salt has been dissolved in the proportion of 2½ kilogrammes to the cubic meter, is introduced into the electrolytic vat. Under these conditions there are formed hypochlorites, or at any rate combinations of oxygen and chlorine possessing the power of destroying malodorous products and infectious germs. This disinfecting and antiseptic solution is drawn into a reservoir whence it is piped to the street. It is used for washing and sprinkling.

At the present time when matters of sanitation demand special attention, and when the problem of rendering sewage innocuous demands solution, the electrical means of disinfection become of paramount importance. Sewage from the Paris mains is partly employed in irrigation in the plains of Gennevilliers and Acheres on the left bank of the Seine. The system was commenced in 1872, and several hundred acres are now under treatment. During part of the year irrigation is not possible, and even if it were there are still collected in these fields almost all the disease germs of the city of Paris. The land becomes then a place for germ culture, and is a constant menace of an epidemic of infectious disease. It seems to be both necessary as well as prudent to sterilize the sewage.

The several electric processes of purification will be recalled. Among others are that of William Webster, tried in England, and that of Hermite, which has for some years been employed at Rouen, with results which, if not decisive are at least very encouraging. These processes are familiar. The sewage water with some chloride added (common salt or chloride of iron, for example) is caused to pass through the electrolytic process. This direct means of treatment is perhaps impracticable in a city like Paris, inasmuch as the amount of sewage water reaching the collecting reservoir at Asnieres ranges from 300,000 to 600,000 cubic meters daily; but an indirect method is perfectly feasible, which would consist in adding to the sewage a concentrated solution of electrolytic hypochlorite.

The problem of electrolytic disinfection becomes simple and practicable wherever sea water is procurable. On board vessels where motive power is available it will be a simple matter to prepare the solution. And seaports, which are almost always infected, can be readily supplied with this simple chlorine disinfectant. Let the sanitary commissions of ports, which so often are the starting points of epidemics, utilize these processes, and we will no longer see cholera at Toulon or at Havre, or at Hamburg. No antiseptic can be prepared more economically than electrolyzed sea water. The foregoing is a translation from a recent issue of *Electricite*.

Electrical Development in 1892.

In a recent issue of the *Chicago News Record* considerable space was devoted to a review of the business development during last year. A particularly interesting article was contributed by William Taylor, Chicago, on the growth and prosperity of the electrical industry during the last twelve months. Following is an abstract:

The year just closed has been an eventful, prosperous and progressive one in electrical circles. Electricity was apparently brought much more prominently to public attention than ever before, and a closer acquaintance resulted in the dissipation of much of that superstitious dread with which the unknown is often regarded. The general prosperity enjoyed throughout the land resulted in the installation of many new plants for lighting and power purposes, and increases to existing plants were as numerous as blossoms in May. Many manufacturers of dynamos and motors have orders booked which will keep them busily at work for several months if not another order is received. Manufacturers and dealers in electrical supplies have been kept busy for months past, working factories, shipping departments and clerical forces overtime in a vain attempt to fill with reasonable promptness the orders received.

The consolidation of the Thomson-Houston and Edison General companies was a boon to outside manufacturers and dealers in supplies, as no matter what was intended to be the result, the combination took off much of the well-organized, aggressive and almost bitter competition which these companies were carrying on. This competition did not exist only in relation to the larger machinery, but was carried vigorously through all the petty sundries which go toward making up an electrical supply man's stock in trade.

Electric light workers in our own city have not been inactive during the past year. At the World's Fair grounds plants have been installed which reflect credit on all connected with them, and the different lighting plants on our south, north and west sides have been extending in all directions. The establishment of an Edison plant on the north side is a decided benefit to that locality. In the center of the town our lighting station friends, in spite of the smoke-prohibition movement, have been actively extending their service wires, not only for light but also for power, thus actively co-operating in the abatement of smoke, through the doing away with the necessity for numerous small furnaces, with that society that is trying to make life a burden to them before those down draft furnaces are brought into action.

Our different railway companies are awakened to the benefits and possibilities of electric lighting and are spending money freely for the illumination of yards and tracks. The Pennsylvania road in the East is perhaps the most enterprising in this direction.

An important addition was made during the year to our electrical manufactories by the establishment of the Siemens & Halske Electric company of America. The machinery manufactured by this company has a world-wide reputation for efficiency and durability, and there is no doubt that it will take the field in a very aggressive shape as soon as its manufacturing arrangements are completed.

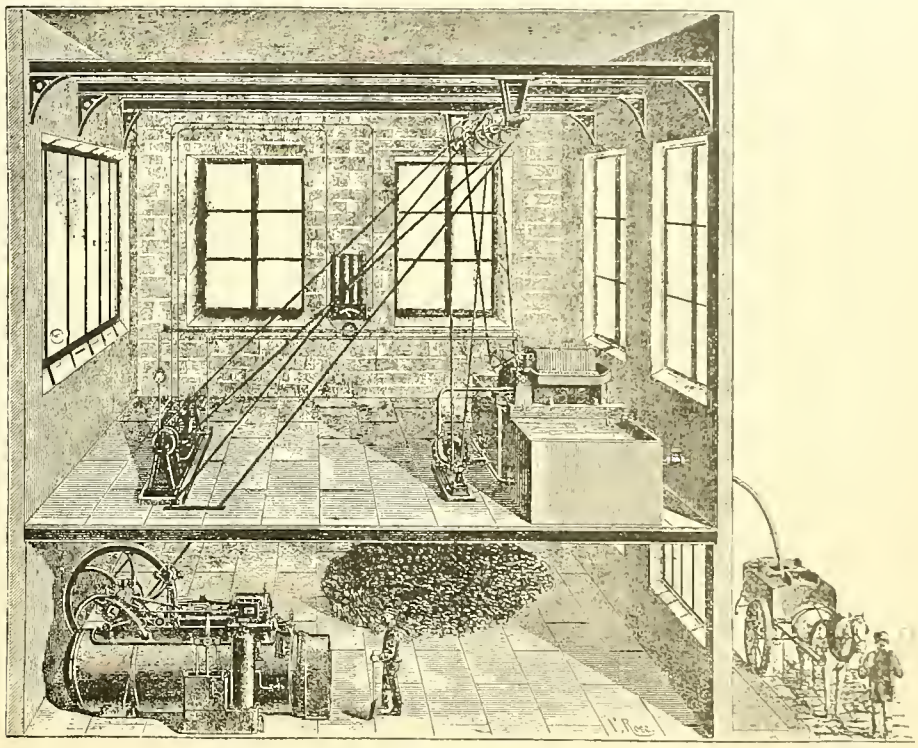
While electric lighting has been advancing with giant strides, the friends of the electric motor have not been idle. Motors of all styles and sizes are daily becoming more generally used. There is the toy hundredth horse power motor, which the small boy found in his Christmas stocking, and the 900 horse power electric locomotive now being built for the Northern Pacific, and which rumor says is for use in Chicago yards. At Messrs Fraser & Chalmer's factory shafting has been discarded, and a number of motors of varying sizes have been substituted, thus saving power otherwise lost through long lines of shafting, which at times must be run practically idle. Many other factories are preparing to follow this example.

At one of our cold storage plants automatic coal conveyors are operated by electric motors, thus practically doing away with manual labor in connection with firing. The elevators are operated by motors, thus dispensing with the use of steam in one of its most expensive forms, and a small eighth horse power fan motor, at a certain pitch, keeps the air in motion and the temperature uniform, otherwise, with all doors and windows closed, the movement of the air is so slow that the top of the room would become too warm, and the bottom too cold. Our Rush street bridge is swung by an electric motor. The Northwestern road, that at present employs motors of from ten to thirty horse power for various purposes, and down to half horse power motor for cutting tickets, is contemplating following the example of the city and swinging its bridges by means of electric motors.

Electric locomotives are now in use in the tunnels under the streets of Baltimore, the steam locomotive, with its dust and smoke, being no longer considered suitable for such work.

During the past year the first conduit electric road was installed in our city, and is now in successful operation on the north side. The "deadly overhead trolley" also gained admission within our city limits, to the great delight and satisfaction of the general public and of long-suffering suburbanites accustomed to standing up in crowded, badly ventilated, cold, uncomfortable, and slow-going horse cars. The south side was fortunate in securing the first overhead electric road, and the west and northsiders are praying that they may soon be favored in a similar manner. Why the overhead trolley is called "deadly" is a mystery to every one except the man who has an underground system which he wishes substituted. If a trolley wire killed one horse for every 100 men killed in our cable road tunnels, and by cable cars, grade crossings and runaway horses an indignant public would rise in arms and burn the poles and melt the trolley and feeder wires. Why, therefore, do some people and papers cry out so hard against the use of overhead wires because there is a remote possibility, under circumstances highly improbable, of killing a horse, and at the same time accept with good grace conditions which result in daily death and murder? In crowded districts, where the expense permits, conduit roads are preferable, but where the expense is too great to permit of conduit construction, the overhead trolley is much preferable to other means of locomotion and safer than a majority of them.

We have fan motors in all sizes and for all purposes, from fanning the patient in the sickroom to exhausting the air in kitchens of our larger hotels. We have motors ranging from quarter to fifty horse-power in daily use and for a countless variety of purposes. Our street cars are operated by motors and we have electric locomotives taking the place of steam locomotives because they are cleaner and, therefore, of less danger to public health. The field for the application of electric power is almost unlimited and 1893 promises to be one of the most active and prosperous years in the history of the business. Not only will a large number of street railways be converted from horse to electric power, but electric roads will be constructed to connect neighboring towns and villages, covering distances that were impossible to cover to advantage or profit with horse or cable cars.



AN ELECTROLYTIC DISINFECTANT.

Although up to the present time it has not received the attention directed to electric light and power, electric heating is now being carefully studied and looked into by experts in all parts of the country. The warming of electric street cars by electric heaters is an established custom, and sundry electric heating and cooking apparatus, such as curling irons, flat-irons, foot warmers, parlor stoves, boilers and cooking utensils of all kinds can be purchased through almost any electrical supply store. Stores are being heated by electricity in connection with hot water pipes, and the heating of steam cars by the same means is receiving careful attention.

A case was called to the writer's attention a few days ago where our government was seriously considering the advisability of dispensing with all other forms of light, power and heating and cooking apparatus at a certain military post and substituting electricity. There is no doubt that before the close of 1893 wonderful strides will have been made in this direction and electricity will have been found as useful for heating and cooking as it has proved itself to be for lighting and power.

The Union Street Railway company of Santa Rosa, Cal., will build four miles of street railway extension and will probably change to electricity.

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THE latest announcements from the Westingbouse company describe the new lamp considerably in detail. It now seems reasonably certain that the new lamp cannot be considered in any way an infringment of the Edison patents, and the fact that the Westinghouse company is manufacturing the lamp in large quantities and receiving orders for it in lots as high as 50,000, must convince all fair minded persons that the Westinghouse company has not been carrying on any bluff in this matter, but that it believes thoroughly in its new lamp. With this question and that of infringement out of the way, the only remaining problem would seem to be that of the performance of the lamp in actual service. And in this connection it may be a matter of satisfaction to lamp consumers in general to know that the new lamp is not without friends among experts, who declare that it is a success.

THE fact that the Perkins lamp factory has been closed by a temporary injunction restraining the company from manufacturing and selling incandescent lamps is no indication of the policy of the General Electric company toward rival lamp companies in general. The action upon which the present injunction was granted has been pending for some time, and like that of the Sawyer-Man and Westinghouse, is old litigation. Should the General Electric company, however, begin proceedings against a competing lamp company with whom, previous to the Sawyer-Mann injunction, it was not in litigation, it may be considered an indication of its policy to drive the smaller companies out of the business. The Perkins injunction cleaned up, we believe, all old litigation, and the next step of the General Electric company will indicate its real policy as affecting the lamp trade in general, and will therefore be looked for with great interest. That it will be a liberal policy, and thus for the best interets of all concerned, the General Electric company included, is the hope and belief of all those who do not wish to see the progress of so great an industry hampered and retarded by a patent with less than two years of life remaining to it.

OUR services are always at the disposal of our esteemed contemporary, the *Electrical World*, when it bungles its facts in relation to the World's Fair matters. We are therefore constrained to remark that the item in last week's issue about "The Large Search Light for the World's Fair" is all wrong in so far as it relates to the past, present and future use of the light. Schuckert's four-foot lamp was brought to the World's Fair last summer and was mounted on the tower of the transportation building to signalize the dedication of the buildings, which took place in the middle of October. Immediately after the ceremonies the lamp was taken to pieces, taken down and boxed up, in which condition it will remain until April. It is therefore inaccurate to say, in January, that this search-light "will be placed on the tower of the transportation building and is intended for the illumination of Jackson Park." The *World* could have obtained exact information by consulting the WESTERN ELECTRICIAN of October 29, 1892.

A CURIOUS controversy has arisen in England over the publication of Gilbert's "De Magnete," and the discussion has developed an international phase. It seems that an organization known as the Gilbert club has been in existence for several years in London, its object being the translation and publication, with proper notes, of the work mentioned. Prof. Silvanus P. Thomson is one of the leading spirits of this society, and just now he is in an unpleasant frame of mind because a New York firm of publishers has announced an annotated translation of "De Magnete" by Mr. Mottelay. This work is now in press, and Prof. Thomson is greatly distressed at the prior appearance of the American translation, seeming to be possessed of the idea that the Gilbert club had in some way secured proprietorship of the exclusive rights to the work of Gilbert, who flourished two hundred years ago. James Dredge, editor of *Engineering*, and one of the English World's Fair commissioners, has taken up the cudgels in behalf of Mr. Mottelay and the American publishers. He says that he advised Mr. Mottelay to publish his translation, fearing, with the latter, that injustice would be done the work by the Gilbert club publication, "owing to what he (Mr. Mottelay) considered Professor Thomson's surprising want of knowledge on the subject." Mr. Dredge speaks of Prof. Thomson as an "abusive gentleman" and alludes to his "scurrilous attack," and declares himself to be primarily responsible for the Mottelay edition. At this distance it appears that Prof. Thomson's complaint is totally unfounded, and that the Gilbert club has no more right to reproduce the work of the scientist after whom it is named than any other individual or corporation in England or America.

THERE have been of late quite a number of accidents from electric cars. And there have been so many of them that the general public not electrically informed, it may very reasonably be presumed, is now almost convinced that in an electric car there must be some peculiar feature which renders that vehicle especially dangerous as compared with a street car propelled by other means. That the nonsense which has all along been published by the daily papers has had a great deal to do with forming this very natural but erroneous opinion is plain to anyone familiar with the practical working of the electric system. It is only fair that the public should be made to see the matter in its true light.

An electric car running through the streets at high speed is just about as dangerous as any other car driven at the same speed under the same conditions. In other words, there is nothing about the car itself that can injure one; it is the high speed which brings in the element of danger. A leaden bullet thrown by the hand can do but little damage; but let this same missile be discharged from a gun and its high speed makes it a "deadly" device—like the high speed street car. It is most unreasonable, then, to characterize the high speed electric car as particularly dangerous, and, at the same time, neglect to point out the fact that any other vehicle run under like conditions would be as dangerous, if not more so, for the case with which an electric car can be reversed or otherwise handled is now generally recognized as a feature which gives the electric system a decided advantage over its alleged rivals.

Rapid transit is now the cry. The people demand it, and the street railway companies look about for the best means through which to give it. An electric system is chosen, and then when the new fast schedule goes into operation accidents occur. Then, because the system is an "electric" one and the good folk of the town have heard it said, or read in the newspaper, that men have been killed by the electric current, there is set up the bowl of "danger."

There is nothing new in the situation. It is the same old story that was rehearsed over and over even before an electric car was conceived. Cars of any sort cannot move rapidly through the streets without doubling the peril of accidents, particularly at crossings with other railroads, and electric motors introduce to a more or less degree exactly the question of safety long debated about steam railroad crossings, and which has by general demand been partly solved through the use of safety appliances. As the use of trolley cars continues to extend through city streets or country roads, safety to the public will surely require, as on steam railroads, that crossings be protected by the best apparatus. Electric railway men cannot pay too much attention to this point. They may not feel an immediate need of such provisions, but they could do far worse than look a little ahead. Give the public its much-needed rapid transit; but at the same time spare no expense to provide such service and equipment in the way of improved brakes and other safety devices that will reduce the chances of accidents to a minimum.

THE question as to which has the better right on highways, overhead trolley electric wires or telephone wires, which has generally been decided in favor of the former in this country, is up in the English courts. A case in point is the action brought by the National Telephone company against Graff Baker, which was recently on trial. The defendant established an electric street car line operated on the overhead trolley system in Leeds, and the telephone company, which uses a ground return, brought suit to restrain the operation of the tramway line on the overhead trolley principle on the ground that it interfered with the transmission of telephone messages on the circuits contiguous to the trolley line. On the trial a Mr. Massey was called as a witness for the plaintiff, and in giving his evidence he took occasion to give his views on some alleged features of telephony in America. Here is the report:

Mr. William Henry Massey was next called, and, examined by Sir Richard Webster, stated that he had heard the evidence given by Dr. Hopkinson, Lord Kelvin and Sir Frederick Bramwell, and, speaking generally, agreed with so much of it as he could understand. Looked at from an English point of view the overhead wire system was horrible. Of course, in America it did not matter. English streets were not filled with telegraph poles and telephone poles and electric lighting poles as they were in America; one pole more or less did not matter over there. At Cardiff, they had come to the conclusion, on witness' advice, that an overhead system should not be allowed. If there was a discharge of the same character from an electric lighting as from an electric traction network, he would expect to find the same disturbance. He had been to Leeds himself. He did not go there specially. He heard the telephonic disturbance. In one case he could not get his message through. He prided himself on being able to speak rather well on the telephone.

Mr. Justice Kekewich: You are rather good, you say, at speaking?—Yes.

Are you good at hearing?—It depends who is at the other end. I manage pretty well with the American voice, what I call the penny-trumpet voice, and shrill, squeaky voice; it is suitable for the telephone. An American voice could go through a fearful noise, which I can discount.

Cross-examined by Mr. Bousfield, witness stated that at Leeds he spoke from the Tramway company's central station to the Steam Plough works, and also to the Great Northern hotel in Leeds.

Mr. Bousfield: Do you know whether the gentleman at the other end had the penny-trumpet voice which is so admirable on these occasions? No, he had not; still he has got a pleasant voice—not a gruff voice.

We have not all of us the same idea as to what is a pleasant voice. You are the gentleman called as a witness from the æsthetic point of view, are you not? No, I am called as a witness to speak to facts.

You do not like the overhead system?—No, I do not. I have seen so much of it that I think it is altogether wrong. I object to overhead things altogether. I think they are a nuisance and unnecessary.

Mr. Justice Kekewich: That is rather strong.—It is, my lord.

So the American voice is the "penny-trumpet voice," and is good for the telephone on account of its squeakiness. Truly, we are compelled to go across the water to learn our peculiarities from the out-spoken Britishers. But the news will excite general interest here on account of its novelty, and perhaps it can be used to advantage in affecting telephone rates. At any rate it is more pleasant than the intelligence that our streets are filled with poles bearing electric wires to the extent that a pole more or less does not matter. That is too bad.

Opposition to the Evanston Electric Railway.

Considerable opposition has developed among Evanston avenue and North Shore property owners to the proposed electric railway between Chicago and Evanston. Opposition to the building of an electric railway comes chiefly, if not altogether, from persons interested in property south of Graceland avenue, while those who favor the scheme have their holdings north of that avenue. The opponents urge that the new scheme will not do away entirely with the necessity of transferring, although it is the intention of the North Shore company to take on North Side street railway trailers.

Adolph Schoeninger, who represents this wing of the property owners, expressed the opinion that the electric railway proposition is only a scheme to get another nickel out of the people. J. L. Cochran, W. T. Lubeke and several others argued that there was no hope of making Mr. Yerkes extend his cable line, and that the North Enders had better take an electric line while they could get it, than wait for something they would never get.

There were hints in relation to an elevated road, and D. H. Londerback, financial representative of the North Shore company, announced that he had told Mr. Cochran and E. A. Blake that if they would get a franchise for an elevated road his company would build it. That proposition was still open, he said, and it was backed by subscriptions of Chicago capitalists to the amount of $800,000, and by a construction company in New York with $40,000,000 capital.

A Praiseworthy Competition.

One of the best managed electric railway systems in the country is that at Rochester, N. Y., owned by the Rochester Railway company, of which John N. Beckley, ex-president of the New York Street Railway association, is the head. Excellent relations exist between this company and the public, and also between the company and its employes. Some time ago the company voluntarily raised the wages of its men, and now it has successfully carried through another project for the betterment of the service. A little over a year ago it was announced that on Christmas day, 1892, the company would give prizes to its motormen and conductors to the amount of $1,000. It was stated that the sum would be divided into two parts of $500 each, one for motormen and the other for conductors, and that each of these parts would be subdivided into four prizes of $200, $150, $100 and $50 respectively. General excellence and efficiency in service was to be the basis of the award. Freedom from accidents, neatness of car, courtesy to patrons, neatness of personal appearance and strict observance of all the rules of the company were the principal points taken into consideration. In order to decide the question among 475 men a tabulated statement was kept showing just what every conductor and motorman had done. When the records were examined it was found that ten motormen and five conductors were tied for the first prize in each class, and there were ties for each of the other prizes. The amount to be divided was increased to $1,330. In all 55 men received prizes ranging from $40 to $10 each. The company is well satisfied with the experiment.

Consolidation in San Francisco.

The Edison Electric Light & Power company of San Francisco has absorbed the Electric Improvement company. A year ago the Edison Electric Light & Power company absorbed the California Electric Light company. The price paid was $1,000,000, in 10,000 shares of $100 apiece. The deal had been made on July 2d of the same year, but the deed was not filed until November 2d. The property transferred consisted of the lots of land and electric light plant on Stevenson street, west of Third street, a lot at Third and Jessie streets, and a third lot on Clarence and Townsend streets, with brick improvements. At the same time two franchises granted by the supervisors for laying conduits for the transmission of electricity, and all the patent rights for the distribution of light, heat and power owned by the California company, were conveyed to the Edison company, subject to a mortgage of $300,000, held by the California Safe Deposit & Trust company.

In the spring of 1891 the California Electric Light company put in a large new steam plant on Clarence and Townsend streets, including no less than fifteen steam boilers, and two large horizontal high pressure condensing engines, with dynamos and all the necessary apparatus for supplying electric light. It was this plant which added very largely to the price of the transfer, and figured as one of the heaviest contributions to the $1,000,000. At that time the plant on Third and Jessie streets was comparatively small. Last year, however, it also has been largely increased. A plant of twenty-eight boilers has recently been set up, furnishing steam to six horizontal engines of 1,200 horse power each, or 7,600 joint horse power. The plant is inclosed in a brick building 80 feet front, 160 feet deep, two stories in height, and having a brick chimney 175 feet high above the street level. The building cost $30,000. The company furnishes about 10,000 lights at present, and about 400 horse power for motive purposes.

The Electric Improvement company has also extensive works. Its headquarters are at 35 New Montgomery street. The company has a large plant on Davis and Vallejo streets, at the northeast corner, another on the corner of Mission and Fremont streets, and storerooms at 597 Mission street. It obtained several years ago from the harbor commissioners a contract to light the water front. This company, though it has no franchises to erect poles in the city, has nevertheless stretched its wires over the house tops on the north side of Market as far as Sixth street, and also into Chinatown. The competition between the two companies ran the price for light below cost, and it was apparent that a consolidation of some kind was inevitable.

C. S. Sergeant.

C. S. Sergeant, the new general manager of the West End Street Railway company, Boston, whose portrait is herewith presented, is a man of considerable experience in the management of large corporations. He is about 40 years of age and has been with the West End company almost from the date of the consolidation of the street railroad interests of Boston. His first business experience was in the First National bank of Easthampton, Mass., where he occupied the position of teller. Later he became cashier of a railroad at Lake Superior, Mich. When the Eastern Railroad company was organized he returned to New England and was made chief clerk, and afterward auditor of the road. This latter position he accepted the year before the Boston & Maine gained control of the Eastern. When the West End corporation was formed he

C. S. SERGEANT.

was appointed its auditor. The accounts were in a bad shape, and he undertook the herculean task of straightening them out. At that time the science of accounting had not been very skillfully applied to street railroads. Mr. Sergeant, however, evolved an excellent system of bookkeeping for street railways which has since been adopted quite generally by other large railway companies. Last year he was elected second vice-president. Now that he is general manager of the road he has in his charge a corporation which has a car mileage greater than any other road in the country. The daily car mileage of the West End company is nearly 50,000 miles. The total mileage for last year was 17,000,000 miles.

Mr. Sergeant is not a man of large physique but is full of resources, and it is said that no man is better acquainted with the details of operation and management of the West End company and its plant.

Injunctions Against the Perkins and Mather Companies.

Judge Shipman, of the United States court at Hartford, Conn., granted an injunction on January 6th against the Perkins Electric Lamp company, on the application of the Edison Electric Light company and the Edison General Electric company. The injunction restrains the Perkins company from manufacturing, selling and distributing incandescent lamps. An injunction was also granted against the Mather Electric company. These injunctions are temporary, and the trial of the suits has been set down for the February term.

The injunction against the Perkins company is without limitations, but in the case of the Mather company there is the same limitation as was made by Judge Lacombe in the recent case against the Sawyer-Man company of New York. This limitation provides that users of the Mather machinery who installed or purchased their apparatus prior to July 1, 1891, can obtain lamps for their apparatus from the complainants on reasonable terms

American Institute of Electrical Engineers.

The seventy-third meeting of the American Institute of Electrical Engineers will be held at the headquarters of the institute, 12 West Thirty-first street, Tuesday, January 17th, at 8 P. M. The paper to be presented is entitled "Electrical Recording Meters," by Caryl D. Haskins, manager of the meter department, General Electric company, Boston, Mass. Beginning with this meeting, the new arrangement for the publication of papers goes into effect, by which the advance copies usually printed for the use of those in attendance will be made the regular mail edition of the transactions. It is the intention of the managers that they shall reach the membership on or before the date of the meeting. Owing to the frequent delay of printed matter in the New York postoffice, those who may wish to participate in the discussion are advised to have a copy mailed at first class rate, which will be done upon application to the secretary. The council will meet in the secretary's office at 5 o'clock next Tuesday.

Locating Trouble on Arc and Power Circuits in Central Station Work.[1]

By C. O. Poole.

As the title of this paper indicates, its object is to deal with the process of locating trouble on overhead construction in arc and power transmissions, rather than to suggest remedies or attempt to improve the line work.

There is an old saying that "if a fellow looks for trouble he is sure to find it very quick." While this may be true when said of a man armed with a club looking for his neighbor's dog, it does not hold good when applied to a lineman armed with a pair of spurs and magneto bell, looking for an open circuit, or a short circuit, or a ground, or a cross, as the case may be. And it is by no means a pleasant undertaking, when the customers, whose lights are not burning, are making the telephone wires hot, and the superintendent's heart sad with these questions and complaints: "What is the matter with our light?" "Will it be going soon?" "Is anybody else's light out?" "Is this likely to occur again?" "What is the reason it don't burn?" "I have tried the broom handle and it don't do any good, there must be something the matter with the lamp; send a man down to repair it." The superintendent will have to reply to this torrent of questions, with all the suavity at his command, and present explanations and apologies sufficient to satisfy any man other than one whose place of business has been left in darkness for several hours because the linemen with their spurs and magneto bell and hampered with rubber coats and gum boots, had been unable to find the cause of the annoyance on a circuit 15 to 20 miles long, and consequently those 50 or 60 lights, if 9:30 lights, did not burn that night; or if 12 o'clock or all night lights they did not burn until late in the night.

It is of such cases as these, which are by no means uncommon, that I wish to speak. I am aware that many means have been employed for testing purposes; but most of them have been too complicated or too expensive or unreliable or for some other cause have been discarded, and the old reliable magneto bell looms up in all its greatness.

When a lineman is sent out on a circuit to find trouble, he knows three things: First, the circuit he has to go out on; second, that there is a ground, a cross, a short-circuit or an open circuit; and last but not least, that if he does not find it in short order he will hear from the superintendent.

If it be an open circuit and he has the advantage of working in day light, the first thing he does is to ground both legs of the circuit at the switch-board in the station; then with an assistant go to the first convenient lamp on the circuit, open the circuit at the lamp, ground one side of his magneto bell and test both ways toward the grounded ends in the station. Suppose he is working at the first lamp on the positive leg he tests that wire back to the station and fails to get a ring; he knows then that the open circuit is between the station and where he has made the test. He then traces the circuit back toward the station until he finds the break. If, however, he should get a ring when he tests the positive wire toward the station, he then tests the other end of the wire, and finding it open continues his search in that direction, until he passes the break and gets a ring on the negative leg; he then knows, of course, that the point lies between the last place of testing and his present position. If a circuit should open at night during the run, the following method is sometimes used to advantage: The lineman instructs the dynamo tender to leave the machine on the circuit; he then arms himself with a pair of spurs and a short piece of wire, and for once the magneto bell is not in it. His knowledge of the circuit enables him to soon reach a pole where both legs of the circuit are on the same cross-arm. Buckling his spurs on he quickly mounts the pole, and baring the circuit wires, brings into service the short piece of wire before mentioned, with which he strikes both of the circuit wires. If a flash is the result, he knows that he has to go further out on the circuit. After climbing another pole some distance further on, and going through the same process of striking the wires, and failing to get a flash, he concludes of course the trouble lies between the first and second test. As soon as the broken ends are reached and spliced together the lights immediately start up. That is one advantage of having the machine on the circuit, while there is the disadvantage of working

1. Read before the California Electrical society, San Francisco, December 18, 1892.

with the machine that is liable to jump at you with about two or three thousand volts, which is by no means a pleasant thing to handle on a wet night.

In order to overcome this danger, and to allow the lineman to become a little more sociable with the circuit he is working on, the company I am with has had constructed a machine to put on this circuit, instead of the regular arc machine; the boys call it the "jigger." It is simply a combined motor and dynamo connected together on the same shaft. It is placed on a roller platform, and stands in the corner of the station until wanted. The motor is wound for 10 amperes, constant current, and has a capacity of about 2 horse power. The dynamo is wound for constant potential, with an out put of about 15 amperes at 200 to 300 volts. When required, the motor part is connected in the arc circuit and is run up to speed. The dynamo terminals are connected to a suitable plug, and a plug put in the circuit that is open. You will readily understand, if the wires be short-circuited as before mentioned, a current will immediately be generated and a flash will be the result.

Not knowing of any better methods than the ones above described for locating a break in the open circuit, I cannot offer any suggestions that would be of benefit. Of course, if the wire should break, and one or both ends fall to the earth, and make a fairly good ground you would by means of the Wheatstone bridge and galvanometer be able to make an intelligent guess, that is all. There are so many doubtful points to be considered in measuring lamp circuits that it makes a calculation almost worthless. For instance, if you had to depend upon the path through the carbons of a lamp, the resistance may be a fraction of an ohm, or it may be 10 ohms. Again, if the carbon be burned out in a lamp that depends upon the current to keep the cut-out in contact, then you would have to deal with the reistance of the shunt winding, which would amount to 200 or 300 ohms.

Another element of uncertainty that might be mentioned is that of induction. I remember one case in particular. After personally going over all the lamps on the circuit, which was about 15 miles long and consisted of No. 6 B. & S. wire, I attempted to measure it with the bridge and galvanometer. I found it impossible to get a satisfactory reading. One instant 30 or 40 ohms would almost balance, and the next instant it would take 400 or 500 ohms to bring the needle to anything near a standstill, while in the next instant it would be found down at zero, with the negative sign before it. The bridge was one of the best, and the galvanometer a Thomson reflecting instrument; both having been previously tested and found correct. The only way that I could account for the phenomena was in the fact that for some distance the lines ran parallel on the same pole with a live circuit. So, everything considered, in my opinion the bridge and galvanometer is not a satisfactory method of testing lamp circuits. I will say, however, in this connection that in some few cases, by the use of the bridge, I have determined the position of grounds and short circuits on trunk lines and on circuits where the trouble occurred between the station and the first or last lamp.

In instances of this kind, the uncertainty of lamp measurements need not be taken into consideration, and the question resolves itself simply into a matter of measurements and calculations. As an example, suppose the trunk line of No. 6 B. & S. wire be two miles long, and the wire becomes short-circuited at an unknown distance from the station. If on measuring it you find the resistance to be 4.176 ohms; and upon referring to a table of resistances you find the resistance of one mile of No. 6 wire to be 2 088 ohms; dividing 4.176, the measured resistance of the circuit, by the resistance per mile of wire 2.088, the result will be 2; meaning, of course, that the wire measured was two miles long, and the circuit consisting of two wires, would make the distance from the station to the point of trouble just one mile. If the short circuit had been caused by two grounds, their position could have been determined by the same process as just described; the only difference being to connect one post of the bridge to one side of the line and the other to ground. Then if you found a resistance of 2 088 ohms, and considering the ground resistance to be nil, you would know at once that the ground on that side of the circuit would be one mile from the station; assuming, of course, that the measurements be made in the station. After getting your distance, and telling the linemen where to find the trouble, it is a matter of but a few minutes until the circuit is clear, and there is light once more. Now if the linemen had not been told where to find the trouble, and simply to go out and find the short-circuit, it would have been necessary to trace the wires from the station until the place of trouble was reached; or by taking the magneto he could have cut the wires and tested both ways. This might have to be repeated several times; and aside from the disadvantage of having a full line of splices would have taken much longer to locate the trouble.

We have seen now an open circuit and a short circuit are located. Now let us follow the linemen in locating crosses between two circuits. Suppose No. 2 and No. 3 to be crossed. The first thing to be done is to test for a ground. If either of the circuits are grounded it must be found and cleared before the cross can be considered. If the circuit be free from grounds, one of the circuits in question is then grounded in the station, say No. 2 be the one; then with the magneto bell he starts out on No. 3 circuit. The process is similar to that described in finding an open circuit so far as the method of testing is concerned; the difference between the two lies in the fact that in the first case you are trying to find the reason you do not get a ring, and in the second case the reason you do get a ring. After proceeding to a lamp on No. 3 circuit, and taking the wires out of the binding posts of the lamp, one side of the magneto is grounded, by connecting a wire to a convenient water pipe or gas pipe, or if the earth be moist by driving a screw driver into the ground and connecting to that; then with the other side of the bell, the lineman can connect the line wire and test toward the station. If he gets a ring, the point of contact between the two circuits, of course, lies between the station and the place of testing. This will be apparent if you bear in mind the fact that No. 2 circuit is grounded in the station, and when the ground is made on one side of the bell it is equivalent to connecting it to No. 2 circuit, and the only reason the connection is not made to the circuit direct is because it may be a mile or more distant.

Having dealt with the open circuit and short-circuit, and a cross; now let me take up that root of trouble, the "ground." I will venture the assertion that nine-tenths of the outside trouble in central station work is either directly or indirectly traceable to grounds, and if there be any central station men present this evening, I believe they will bear me out in the statement.

Where the lineman is called upon to clear one cross, he has nine calls for grounds; and it is equally true regarding open circuits, although short circuits are frequently found to consist of two grounds. I will recite an instance of this a little further on. If I treat the subject of grounds a little more fully than the others, I do so for two reasons. First, because it is of more importance than any of the others, on account of the more frequent occurrence; second, because it offers an opportunity to use instruments in locating the trouble. The instrument I use is a voltmeter, reading from 0 to 3,000.

The magneto bell method of locating a ground is the same as the one described, that of opening the circuit and testing both ways. With the voltmeter, it is necessary of course to make the test while the circuit is running. I have found it a good practice to go over all the circuits at the switch-board with a ground wire while the lamps were burning. In this way I have frequently detected grounds on a circuit where other methods had pronounced them all right. If upon striking a circuit with a ground wire, you succeed in drawing out a flash about a yard long, and probably have to take two steps backward to break it, you will have a kind of a foggy idea that there is a ground on that circuit, and if, upon examination, you find half your mustache and one eyebrow gone; and it has taken about 10 minutes to recover your eye-sight, then you feel pretty sure that you have found a ground circuit.

For the benefit of the uninitiated, I will say, that this singeing process will occur but once; for the next time the neophyte approaches a live circuit with a ground wire, it will be with a 10 foot pole, and the wire safely fastened at the proper end of it.

Having found a grounded circuit, the next thing to do is to find the ground on the circuit. If there be but one ground on the circuit, it will make no difference with the burning of the lights; but if there is one ground there is sure to be another sooner or later, and then the trouble begins. For this reason, and several others that might be mentioned, it is desirable to keep the lines clear of grounds at all times.

But returning to our problem of locating grounds, we will take the circuit from which comes the flash, for example call it No. 10, and in handling it, treat it with all the respect and deference due its importance. First, with the voltmeter take the electromotive force across the terminals on the switch-board; do not be satisfied with one reading, but take several at intervals of two or three minutes, for the voltage of an arc circuit is anything but constant. Suppose the average for several readings be 2,500 volts. By turning to your lamp list you may find that No. 10 circuit has 51 lamps of the so called 2 000 candle power. For convenience, we will assume the current to be 10 amperes; some systems use this current, others a little less. Again, suppose the circuit to be 10 miles long of No. 6 B. & S. wire. The resistance of one mile of this wire, as before stated, is 2.088 ohms; then 10 miles would equal 20.88 ohms. Now using Ohm's law of E equals RxC, we have 208.8 volts, giving us the electromotive force required to overcome the resistance of the line circuit. This 208 8 volts deducted from the total electromotive force of the circuit, 2,500 volts, leaves a remainder of 2,291.2, being the amount absorbed by the 51 lamps on the circuit. This would give an average of very nearly 45 volts per lamp; just about the proper voltage when burning a 4½ ohm arc. In the calculation with which we are dealing it is of course necessary to take into consideration the 208.8 volts lost in the line. If we divide this 208.8 by the number of lamps on the circuit it will give an average per lamp of a trifle over 4 volts, this added to the average lamp voltage will make a total of 49 volts; so that 49 is the constant to be used in our dealings with No. 10 circuit. We will now connect one side of our voltmeter to ground, and the other side to the positive side of the circuit. If we get a reading of 980 volts, for instance, and divide this by our constant of 49 volts, it gives us 20; which means, of course, that the ground lies between the 20th and 21st lamp on the positive side of the circuit. If now we connect to the negative side and ground, and get a reading of 1,520 volts, by bringing our constant into use we divide 1,520 by 49 which equals 31—locating the ground between the 31st and 32d lamp on the negative side of the circuit; precisely the same result as with the first test, and proving beyond a doubt the correctness of the first calculation. We are about to put our instruments away and resolve to have that ground cleared the first thing in the morning, when our dynamo tender informs us that the machine on No. 10 is running very light; he thinks there are some lights cut out on it, as he had just noticed it flash. Connecting our voltmeter between the ground and positive side as before, 930 volts is the result; just the same as we had left it a few minutes ago. Connecting now to the negative and ground, we find our reading to be 540 volts, instead of 1,520 as before. Dividing 540 by the constant 49, gives us 11, showing conclusively that another ground has appeared on the circuit between the eleventh and twelfth lamp on the negative side. Now disconnecting the instrument from the ground and placing it across the terminals instead of a reading of 2,500 volts, we get but 1,520 volts. This divided by 49 equals 31 lamps left burning on the circuit; 31 from 51, the total number, leaves 20 lamps cut out by the grounds.

The number of lamps cut out could have been calculated without taking the terminal potential, by simply adding the two ground readings and deducting their sum from the terminal potential previously obtained, and dividing the result by the constant 49. All central stations have or should have maps of their circuits, showing on what streets they run, and the location of the lamps. If such maps be at hand we take out No. 10 circuit map, and counting 20 lamps from the station on the positive leg we locate one ground, and counting 11 lamps from the station of the negative leg, locate the other. Now when we call the lineman we do not simply tell him there are two grounds on No. 10, but we tell him to go to the corner of Twenty-first and B streets for one and Fifteenth and A streets for the other. If the maps above referred to are not to be had then you have to depend upon the lineman's knowledge of the lamps and circuits.

A short time ago I had a very peculiar case of ground to deal with; it had been raining and storming for several days, and circuits without grounds were held at a premium. One of our day circuits of 50 lamps was reported out; not a lamp on the circuit burning. A test showed the circuit to be grounded. Linemen were sent out on the circuit, but after tracing it from one end to the other, failed to find the trouble. The machine was kept on the circuit all the time, running at 10 amperes, on almost a dead short circuit. When the first lineman failed to find the trouble another was sent out with the same result. Things were becoming interesting. I took the voltage of the circuit and got a reading of 40 volts—about that—I don't quite remember the exact figures; between the positive side and ground, about 13 volts; between the negative side and ground, about 27 volts, showing, as had been reported, that every lamp on the circuit was out. By the method described in locating a short circuit on trunk lines. I determined the number of feet of wire from the station to the ground on the positive leg, that being the nearest one to the station, and with a lineman started out to find the cause of all the annoyance. I spaced the distance off with my eye as near as I could, and in 15 minutes from the time we left the station the 50 lights were shining forth in all their brilliancy, and the innocent telephone wire was credited with another knock out. The other ground was found a little later, where the voltmeter had located it.

Electrical Publishing Controversy.

Harold Frederic, the London correspondent of the *New York Times*, tells this story in his cable letter of last Sunday: A queer sort of controversy is proceeding in the weekly columns of the *Electrician*, which has ancient roots in preinternational copyright days, and personally affects well-known Americans. It seems that three years ago a rather noisy scientist here, Prof. Silvanus P. Thompson, organized with some beating of drums what he called the Gilbert club, one of the learned aims of which was to be the translation and publication in sumptuous form of a limited edition of Gilbert's "De Magnete." He says a great deal of work has been done, but is unable even now to give a date for its appearance. Meantime an American prepared a translation on his own account, with admirable annotations, and after consultation with a number of English scientists decided to publish, and John Wiley & Sons of New York announce it as forthcoming from their press. Thompson, at news of this, writes to the *Electrician* denouncing the Wileys as a tainted source and speaks of their evil notoriety as pirates of Ruskin's books and generally talks as if the copyright in Gilbert's mediæval book rested in him. The Wileys have not lacked defenders like James Dredge, British Royal Commissioner to the Chicago Exposition. Thompson returns with fresh attacks on the Wileys and Motteley, calling the former "literary highwaymen" and imputing incapacity to the latter. There seem to be unlimited possibilities of caloric in the future of this discussion.

Fire at the Fort Wayne Factory.

The arc lamp department and armature winding rooms of the Fort Wayne Electric company, Fort Wayne, Ind., occupying a three-story brick building, were almost totally destroyed by fire on January 3d, causing a loss of $32,500. One hundred and fifty employes were temporarily thrown out of employment. The largest machine shop, a building 200 feet long, was saved, and also the office building, the foundry, the storehouses, 300 feet in length, and other departments. The company immediately set about rebuilding, and but slight interruption was caused in the work of the factory. The origin of the fire is unknown. The loss is covered by insurance.

A dynamo has been made from the designs of Sir David Salamons and Lawrence Pyke, for the generation of alternating currents of very high frequency. This machine is intended for experiments in developing the theories and discoveries of Tesla and Crookes. A direct current of 10 amperes at 100 volts is transformed into an alternating current of one ampere at 1,000 volts, with a frequency of 1,000,000 per minute. This high frequency is obtained without an excessive speed of rotation by rotating the field and armature in opposite directions. A relative speed of 3,000 revolutions per minutes is obtained by giving a speed of 1,500 revolutions per minute to each in opposite directions. It is used in connection with a transformer which increases the pressure of the current to 100,000 volts.

W. Forman Collins.

W. Forman Collins, for the past three years western representative for the *Electrical Engineer*, has resigned to accept a more lucrative position as business manager of the WESTERN ELECTRICIAN. Mr. Collins has many friends west who wish him all success possible in his new position. *Electrical Review*, New York.

W. Forman Collins has resigned his position as western editor and manager of the *Electrical Engineer* and has assumed the business management of the WESTERN ELECTRICIAN. Mr. Collins has had a wide experience in electrical journalism in the East as well as in the West, as prior to his connection with the *Electrical Engineer* he held a position on the staff of the *Electrical World*.—*Electrical World*, New York.

It is with mingled feelings of regret and pleasure that the *Electrical Engineer* announces the severance of its connection with Mr. W. Forman Collins, who for more than two years past has been its western editor and manager. There are few electrical engineers of the same age his equal in ability and experience, and he has shown a judgment and a capacity for hard work that will help to carry him far on the road to success. He is still very young, but in the favoring air of Chicago has ripened quickly, winning his position by downright merit. He will now join the forces of the WESTERN ELECTRICIAN under such desirable conditions that the *Engineer* can only congratulate him and wish him godspeed. His new duties connected with the active direction and management of our prosperous western contemporary will bring him heavier personal responsibilities than heretofore, but he will be found in every way equal to the emergency and he will, in his larger sphere of usefulness and activity, broaden and develop in all the good qualities that have already taken him so quickly to the front of western journalism.—*Electrical Engineer*, New York.

COMMUNICATIONS.

Great News from the Coast.

To the Editor of the WESTERN ELECTRICIAN:

Kindly do me the personal justice of publishing this my repudiation of the prospectus referred to in your issue of January 7, 1893, headed "Great News from the Coast." It did not appear over my signature nor from the company I am, or ever was, connected with. Some of the claims in it are absurd and impossible on their face and in fact.

S. J. M. BEAR.

Chicago, January 5, 1893.

Effects of Electric Welding.

To the Editor of the WESTERN ELECTRICIAN:

We notice in a recent number a copy of an article from London *Iron* relative to the unpleasant experiences of operators with electric welding apparatus. In order that there may not be any misunderstanding in regard to this matter, I desire to state that the process referred to in this article is that of arc welding by the Bernados system, and should not be in any way confused with either the incandescent or arc methods in use in this country. By the incandescent method now in general use in the United States, it is impossible that any evil results whatever should follow. The currents used are harmless, and there is no danger of whatever nature that can come to any operator.

As far as our arc welding process is concerned, which we are just introducing into various works, would say that ample precautions have been taken against any bad effects whatever, and that it may be used as generally as our other methods without any of the evil effects described in the English article above referred to.

H. A. ROYCE.

Boston, December 29, 1892.

Storage Batteries.

To the Editor of the WESTERN ELECTRICIAN:

The WESTERN ELECTRICIAN of December 31, 1892, advances some sound ideas in its editorial on the practical use of storage batteries, and the writer is tempted to say something more.

The accumulator, or, better, the secondary battery, is made of chemical mysteries, even to the expert, and much more so to the electrician, who in writing on the subject is far more inclined to treat it slightingly, merely noting another failure, than to spend the time in hunting out the cause of failure.

The "Specialization of Accumulators" is a subject which the waiter has dwelt upon for more than a year, feeling from the results of the first year of his experience, in making and handling accumulators, that they were only practically useful and economical in certain places under certain conditions. The battery for an aid to a lighting plant can be quite a different thing from a battery made for traction work on street cars, or other forms of locomotive propulsion. The large heavy battery of great ampere hour capacity can be made for lighting stations at less proportionate cost than a light, compactly made battery for traction work. The cost of metallic lead, lead oxides and time and current occupied in forming, say 60 hours, is the main expense for the lighting plant. The weight of metal gives durability as well as efficiency. Glass jars can be used; they are much cheaper than those of hard rubber, one of the most expensive items in a battery that must be light.

The lightness of a battery depends much upon what it is to be used for, and what its daily and hourly use is worth. If for instance light carriages could be rented by the hour from central stations, like horses and carriages from a livery stable, then the rental would pay, or could be made to pay, even if fifty per cent. of first cost was added at the end of six months. Batteries are not like horses; they do not eat unless they work, and do not deteriorate while out of use. So there is money for every hour of their use, a small per centage of which goes to restoration and repairs.

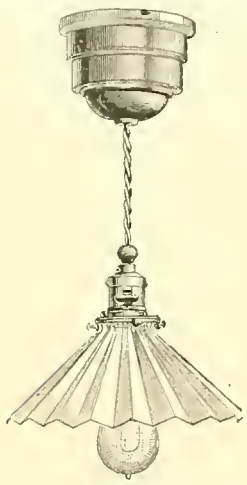
Chicago, January 3, 1893. J. K. PUMPELLY.

Lamp Lighting Schedule for 1893.

The popularity of the "WESTERN ELECTRICIAN Lamp Lighting Schedule" is attested by the demand that has been made for this year's issue. This schedule, which has been issued by the WESTERN ELECTRICIAN for several years, is carefully compiled, and has become the standard for central station managers. It is published in convenient form and should be found in every central station in the country.

The Sisson Automatic Electrolier.

The accompanying cut illustrates a new electric light fixture that is being introduced by the Electrolier Manufacturing company of Pittsfield, Mass. This electrolier is not

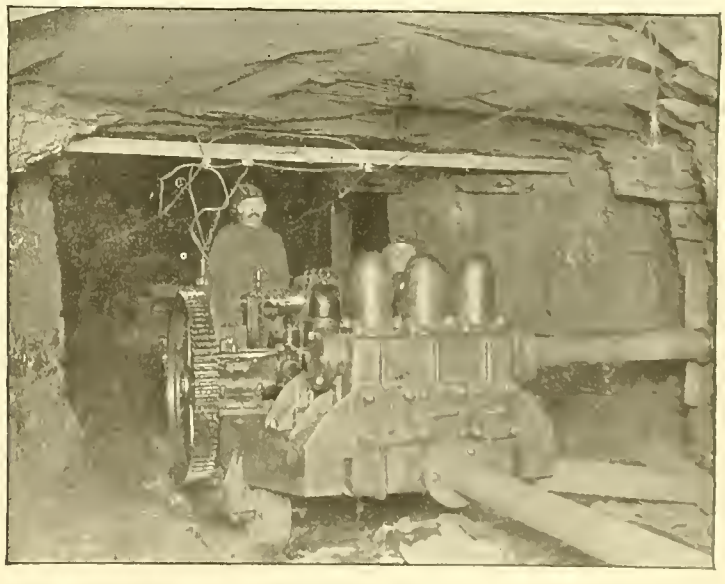


SISSON AUTOMATIC ELECTROLIER.

only adjustable but it combines a fuse block as well. It carries several feet of extra cord, and can be adjusted at any desired height as easily as a window shade can be raised and lowered. With this electrolier installed no unsightly loops of cord are left suspended in the room, all the extra length being disposed of inside the shell. It is adapted, too, for either concealed or visible wiring, and can be attached in a few minutes.

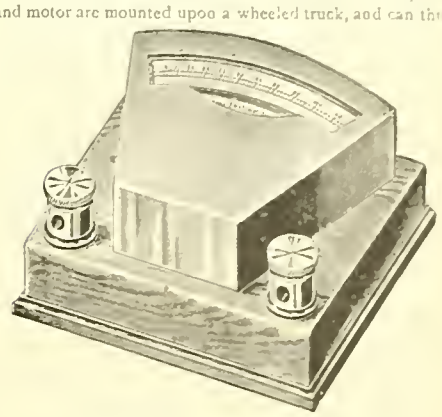
Electricity in Mining.

An excellent example of the manner in which electricity is displacing steam in mining is given in the recent installation in the William H. colliery of the Connell Coal company located in Duryea, Pa.



ELECTRICITY IN MINING.

The feature of the greatest interest in the improved plant is the electric pump, the first introduced in the mines of that section. The pump is of the horizontal, triplex or three plunger style, with 6½ inch plungers and 8 inch stroke. It makes 42 revolutions per minute, and, in its present location, throws a steady, solid stream of water through a 4 inch pipe a distance of 500 feet from the lower workings to the main pump. The capacity of the pump is 500 gallons per minute. Its entire weight inclusive of the operating motor is 6,600 pounds. The electric motor is a 75 horse power machine made by the General Electric company, and the generator, constructed by the same company and located in the main engine house on the surface, is of 70 horse power. The power is transmitted to the motor over copper wires running down through the air shaft and along the roof of the mine for a distance of 1,700 feet. The pump and motor are mounted upon a wheeled truck, and can thus



WHITNEY ELECTRICAL INSTRUMENTS.

be readily transported to any point in the workings. This quality alone is a strong recommendation to mine managers.

By the use of the electric pump a great danger in this mine has been obviated. The steam formerly used penetrated the roof of the mine, loosening the rock and rendering the possibility of its fall always imminent.

Besides furnishing power for the pump, the electric generator on the surface supplies current to the incandescent lamps which light the engine house, the head of the shaft, the inside pump house, and the workings about the foot of the main shaft. The contrast between the incandescent lamps attached to the roof along the main gangway and the illumination sparsely distributed from the ordinary miner's lamp is most striking.

If after a few months' trial of the new system of lighting and pumping it is pronounced successful, the colliery company intends still further to utilize electricity in the mine, and put it to other uses, such as operating drills and locomotives.

Whitney Electrical Instruments.

The cut shows the general appearance of the Whitney ammeters and voltmeters which are being placed on the western market by the Electric Appliance company, Chicago. The instruments are of the permanent magnet type. Every instrument is accurately calibrated and subjected to severe test before leaving the factory. The voltmeters are intended for both switchboard and testing purposes and are divided into class A for intermittent work and class B for continuous work; that is, those of class A are to remain in circuit for short periods only, while those of class B may be kept constantly in circuit. The instruments are provided with a mechanical dead beat attachment, which is operated by touching a button, and is intended to facilitate the taking of rapid readings.

CORRESPONDENCE.

New York Notes.

NEW YORK, January 7.—Last week I wrote you that the prospects of the Rapid Transit scheme presented rather a blue appearance. This week, however, has witnessed some rather curious developments in the matter of the disposal of the big franchise, in which William Nowland Amory poses as the central figure. When Mr. Amory came to the front as sole bidder at the recent auction of the underground rapid transit franchise very little was known about his aims or resources. After bidding $1,000 for the transit privilege, Mr. Amory told the commissioners that he was prepared to deposit $1,000,000 within five days, but his bid was rejected. People wished to know all about the sole bidder for a franchise so important, but Mr. Amory had little to say. Now it appears that Mr. William Nowland Amory is going to make a fight for what he considers are his rights—or at least he talks that way. But it also appears that the young gentleman who can talk so glibly in the language of millions is by no means a Gould or a Sage in that he is at present capitalized on a cash basis at just thirty five cents. This is the amount the *Herald* places to his credit. And furthermore, the same paper was unkind enough to publish the fact that on December 12th a receiver had been appointed to settle Mr. Amory's affairs, stating also that in supplementary proceedings the young man had testified that he owned an aluminum watch, a report of the railroad commissioners, some paper covered novels, a bank account for thirty-five cents, two rings and a limited wardrobe, and had in his possession $2,000,000 of bonds issued by a company which he had helped to organize, but which owned no property, and of the present existence of which he was not certain. Such talk as this did not tend to heighten Mr. Amory's credit. He claims, however, that he will fight the matter to the end, but he still refuses to reveal the names of his mysterious backers.

The belief was, as I wrote you last week, that the commissioners had virtually given up their underground scheme. It seems, though, that they were very angry at the published statements that they were only too willing to give up the underground scheme and to prepare plans for an extension of "L" road facilities. One of the commissioners said the criticisms were the result of a misunderstanding, and Commissioner Steinway declared that the statement he prepared immediately after the auction last Thursday was an answer to any malicious attack which might be made.

The two committees which were appointed by the meetings held Wednesday afternoon in the Real Estate Exchange to consider rapid transit appeared before the commissioners on Friday and submitted memorials and arguments, on the one side in favor of the construction of the underground road by the city authorities, and on the other in favor of giving extensions to the elevated road so as to complete the work of the commissioners through that agency. Both committees were fully represented, and the antique arguments for elevated roads were again gone over. Another meeting will be held next Tuesday.

On Monday the gas commission met and decided to substitute electric lights for the gas lights on Vanderbilt avenue from Fordham to Mott Haven, and also to equip Woodlawn Heights with electric lights.

The trolley "octopus" is a terrible thing, especially when it puts one of its "feelers" into the public's pocket. However, now that an electric railroad between Yonkers and Mt. Vernon is an assured fact, and trolley cars are to be run in the spring, the people of the latter city discover, too late, that they have made no stipulation with the railroad company as to the fare to be charged, and the number of cars to be run each day. The railroad proposes to charge ten cents for the trip from Getty Square, Yonkers, to the Bronx river, which means at least another five cents to Mt. Vernon, and, according to the charter, only ten trips each way need be made daily. Insomuch as the Union Railroad company is to carry passengers from Mt. Vernon to Mott Haven for five cents, and is to run electric cars every fifteen minutes, residents of Mt. Vernon are naturally dissatisfied with the prospects for the trip to Yonkers. Moreover the Westchester Railroad company can charge what it likes and run cars as seldom as it likes between Mt. Vernon and New Rochelle. It owns the entire route from the Bronx river to the Sound. W. F. O.

New England Notes.

BOSTON, January 7.—An amusing contest is being fought out by the Old Colony railroad and the Interstate road which runs an electric line between Attleboro, Mass., and Providence, R. I. It all comes from the rivalry between the steam and electric roads and shows pointedly what a field there is for the latter. The latter has been wanting for some time to lay its tracks across the tracks of the Old Colony at Hebronville. The Old Colony objected to this and stationed a gang of men at the crossing to prevent its rival from stealing a march upon it, but in some way the electric company managed to string a trolley wire across the tracks of the steam road. The Old Colony officials learned what had been done and at once secured an injunction forbidding the Interstate road to lay tracks across the Old Colony crossing. An Old Colony official, when asked the reason for the determined attitude of his corporation, answered: "Since the electrics have been running from Attleboro to Pawtucket there has been an average decrease in our receipts at that small station of $65 every Saturday afternoon. Don't you think that is reason enough for us to object?"

The people of Brookline have petitioned the West End company for an electric service to that town by way of Huntington avenue, Boston. But on account of the poor condition of the avenue and the project which is on foot looking to a widening of the thoroughfare so that the car tracks can be put in a portion reserved expressly for them in the same manner as is done on the Beacon street approach to Brookline, the West End company has been obliged to refuse the petition until improvements can be made.

The big manufactories of Lowell are looking about for a way to obtain electric power for their mills. The Locks & Canals company of that city, which is controlled by the textile corporations, has under consideration a plan for utilizing the waters of the Merrimac river for this purpose. It is proposed to tap the northern canal and establish a power house there. The capacity of this canal is sufficient to take about all the water of the river when it is high and flowing over the dam. In the manner proposed it would be possible to make use of power which now goes to waste. Col. James Francis has the matter in charge.

The latest estimate places the loss of the West End Street Railway company by the burning of its new car stables at Everett at $80,000.

The Connecticut Electric Light association has elected the following officers for the new year: President, Jas. E. English, of the New Haven Electric Lighting company; vice-presidents, Jas. A. Hadley, Meriden Electric company, and Jas. P. Stow, Middletown Electric company; treasurer, John C. English, Bridgeport Electric company; secretary, A. M. Young, Waterbury.

Opposition is being raised to the proposed charter for an electric road through Beverly to Gloucester. Beverly people have held a meeting and appointed a committee to appear before the legislature and oppose the granting of the charter. They say it is too broad, and they allege that the only object the petitioners have in asking for it is to sell out to the North Shore Traction company.

Electricity is making giant strides in Maine. Centralization is in the wind, and the Maine Railway, Light & Power company is to ask the legislature for a charter this winter. The object of this company is to control all the electric railway, light and power companies in the state. There are seven electric roads in the state, the Bangor, Waterville & Fairfield, Augusta, Hallowell & Gardiner, Rockland & Camden, Westbrook, Biddeford & Saco, and Sanford. In addition to these it is expected that the Lewiston & Auburn road will soon adopt electric power. The capital stock of the new company is to be $4,000,000 It proposes to buy the stock of all the smaller companies. A. F. Gerald of the Waterville & Fairfield road is the originator.

The West End Street Railway company has effected a new agreement with its employes for the year 1893. The men asked that all conductors, drivers and motormen be paid $2.50 a day instead of $2.25 which the motormen and electric car conductors are now getting. This the company refused to do, but it agreed to advance the pay of horse car conductors and drivers, so that they are now getting the same amount as the electric car men. A day's work is to consist of ten hours to be done as far as practicable in twelve consecutive hours, and it is never to exceed 10 hours and 20 minutes in 12½ consecutive hours.

The Thomson Scientific club of Lynn has elected the following new officers: President, H. G. Reist; vice-presidents, C. H. Veeder and J. B. Blood; secretary, J. H. Jenkins; treasurer, H. S. Towner; librarian, E. D. Priest; reviewers, C. K. Veeder, J. B. Blood, H. F. Parshall; executive committee, H. G. Reist, C. H. Veeder, J. H. Jenkins, H. S. Towner, E. D. Priest, W. E. McTaggart, F. Holden.

The West End Street Railway company, of Boston, through Pres. Whitney has given $1,000 to each of the widows of the four men who lost their lives at the Everett car stable fire. J. C. E.

Northwestern Notations.

MINNEAPOLIS, January 7.—The municipal electric light plant scheme keeps bobbing up in Minneapolis and St. Paul with the persistency of a Banquo. Every time the aldermen have occasion to let a contract for street lighting or the subject is suggested in any way, the idea of the city doing its own lighting is sure to be put forward and find earnest advocates. St. Paul has recently had another squabble over a light contract. The Commercial club of that city at a recent meeting agitated the matter vigorously and wound up by appointing a strong committee to urge the city authorities to investigate thoroughly the feasibility, expense and general features of an electric light plant owned and operated by the city.

Minneapolis is just now building an immense city and county building, covering a whole block and likely to cost $2,000,000 or $3,000,000 before it is finished. At a meeting of the commission the other day the question of lighting the big building came up. The suggestion of putting an electric light plant in the basement to light the building was promptly supplemented by a suggestion to make the plant big enough to do all the city's lighting. It was figured that by spending about $25,000 more than the building plant would cost additional machinery capacity sufficient to light the entire city could be had. This idea seemed to strike most of the commissioners very favorably. The city is now paying $80,000 a year for electric lights for the streets and has recently made a contract for five years. It will be several years yet before the new public building is entirely completed.

A recent letter contained a brief reference to the completion of a practical test of the Cooper-Hampton patents and the furthering of plans for organizing a company and putting in a large plant in Northeast Minneapolis. Much is claimed for these patents and some heavy capitalists are reported to have taken hold of the enterprise for developing them, among the number Henry Villard and Thomas Lowry. It is claimed that the motor involves principles which, if they can be economically applied, will fairly revolutionize street railway locomotion. To settle the question cars are to be equipped and put in operation. The trial will be made on the Minneapolis street railway system and President Lowry himself will report results. It is said that no exclusive rights have been promised to Villard, Lowry or anybody else. Mr. Lowry has secured a license to use the patents in Minneapolis and St. Paul. The practical test alluded to was the equipment and running of a small car. The real test will come when the trial is made, as it will be at once, with the regular sized cars. No other licenses will be given till the result of this test is known. Beside the street car motor those interested claim great things for the pump and elevator patents. The plans for the manufacture of the appliances are still in embryonic shape, but it is said to be quite certain that there will be a large factory here.

The Northwest General Electric company, H. M. Bylesby, H. C. Lewis, C. H. Maxcy and H. C. Akeley, holding 4,873 shares of stock of the Edison Light & Power company, have petitioned the district court for a dissolution of the corporation. It is stated that the corporation owes about $200,000, and has a chance to sell its building and machinery to such advantage as to liquidate all obligations. After this sale is made the corporation will be practically out of business. The petitioners want to make the sale, pay the debts and have the corporation cease, except that it may remain a body corporate for the time prescribed by the statute, that it may settle debts and make a division of capital stock. The building and machinery referred to constitute what is known as the Edison building, located in the rear of the Lumber Exchange building. The corporation was organized in 1888, and has recently been consolidated in what is popularly known as the "electric combine."

It seems to be settled that Duluth is to get the Great Western Electric company's plant. It is reported that $85,000 of the required $100,000 cash bonus has been raised, and the general manager has been telegraphed to close the deal. The old Iron Bay works are being put in shape to receive the new plant. An important feature of the project will be the building of a mill, in which the wire used in manufacturing armatures and other electrical appliances will be made. H. C. C.

PERSONAL.

Jean A. Wetmore of the Okonite company, New York, was in Chicago last week.

Bertram M. Downs, representing William Brookfield, 83 Fulton street, New York, was in Chicago Monday.

H. Bishop has been appointed general western agent for the Massachusetts Chemical company of Boston. Mr. Bishop has opened an office in the Monadnock building,

Chicago, and will make the World's Fair city his headquarters.

J. P. Kemper, formerly with the Great Western Electrical Supply company, has arrived in Chicago from New Orleans. Mr. Kemper proposes to go into the electrical construction business in this city.

Capt. W. L. Candee, manager of the International Okonite company of New York, left for England last week. While abroad he will visit the company's branch houses in London and Manchester.

H. M. Littell has resigned the position of manager of the Mt. Auburn Inclined Plane and Street Car company of Cincinnati to assume the general management of the New Orleans Traction company, recently organized to control the street car traffic of the Crescent City. Mr. Littell equipped the Mt. Auburn line for electric power, and leaves an enviable record in Cincinnati.

L. W. Collins has been appointed western manager of the *Electrical Engineer*, with headquarters at Chicago. Mr. Collins has been identified with the advertising department of the *Electrical Engineer* in New York for some time, but he is not unknown in Chicago, and his old friends will be glad to welcome his return to the World's Fair city. Before leaving New York Mr. Collins was presented a testimonial by his friends and business associates.

NEW INCORPORATIONS.

Burton Electric company, Albany, N. Y.; capital stock, $10,000; manufacture and sale of electrical apparatus.

Pocahontas Light & Water company, Pocahontas, Va.; capital stock, $100,000; water, gas and electric works.

Sedalia Water & Light company, Sedalia, Mo; capital stock $500,000; constructing water, gas and electric light works.

Havana Electric company, Havana, Ill.; capital stock, $30,000; to operate an electric light and power plant in Havana; J. W. Bronson, Havana, Ill.

New York & Brooklyn Automatic Construction company, Jersey City, N. J; capital stock, $100,000; Eliot Norton, 59 Wall street, New York, N. Y.

Lancaster Electric Railway company, Lancaster, Ohio; capital stock, $100,000; building and operating electric street railroad, etc.; C. P. Bauman, Lancaster, Ohio.

Field Electric Car Life Guard company, Portland, Me.; capital stock, $500,000; to manufacture and deal in life guards or fenders for cars; N. & H. B. Cleaves, Portland, Me.

Denver, Mount Olivet & Golden Railway company, Denver, Colo.; capital stock, $125,000; to build, operate and maintain an electric railway from Denver to Golden, Colo.

Lancaster & Marietta Electric Street Railway company, Marietta, Pa.; capital stock, $90,000; constructing, maintaining and operating a street railway; D. B. Case, Marietta, Pa.

Durango Light & Power company, Durango, Colo., and Denver, Colo.; capital stock, $200,000; to erect a gas and electric light plant in the city of Durango, La Plata county, Colo.

Great Western Manufacturing company, Des Moines, Iowa; capital stock, $1,500,000; to manufacture, buy, sell and deal in electric goods, appliances, wire, etc.; Omer Simonds, Duluth, Minn.

Salmon River Power company, East Haddam, Conn.; capital stock, $50,000; to develop and distribute power, including water power and electric power, etc.; Austin Brainard, Hartford, Conn.

Pacific Grove, Monterey and Del Monte Electric Railway company, San Francisco, Cal.; capital stock, $250,000; to construct and operate street railroad; Carnall, Hopkins & Co., San Francisco, Cal.

Ries Induction Transit company, Camden, N. J.; capital stock, $1,000,000; to manufacture, use, etc., a railway system of propulsion by dynamic induction; C. V. D. Joline, 202 Market street, Camden, N. J.

Union Street Railway company, Santa Rosa, Cal.; capital stock, $50,000; to construct and operate street railways propelled by horse, cable or electricity in Santa Rosa, Cal.; B. M. Spencer, Santa Rosa, Cal.

Girardville Electric company, Girardville, Pa.; capital stock, $5,000; manufacturing and supplying light, heat and power by means of electricity to the public at Girardville, Pa.; MacHenry Wilhelm, Ashland, Pa.

Vicksburg Electric Transit & Light company, Vicksburg, Miss.; capital stock, $2,000; to run a railway in the city of Vicksburg, and also supply the city with electric lights; Chester R. McFarland, Vicksburg, Miss.

Cuyahoga Electric company, Cleveland, O.; capital stock, $10,000; furnishing electric light, power and heat, and manufacturing and dealing in machinery and electrical appliances, etc.; George Sowden, Cleveland, Ohio.

Waterhouse Electric company, Hartford, Conn.; capital stock, $20,000; to manufacture and repair all kinds of electrical apparatus and machinery, buying, selling and dealing in the same, the promotion of electrical inventions, etc.

Hawks Electric company, Boston, Mass.; capital stock, $12,000; purchasing, manufacturing, leasing and selling electrical apparatus, appliances and machinery and patents relating to the same; constructing steam and electric plants for telegraph, telephone, electric light, power and electric railways; manufacturing and selling electricity for light, heat and power, and carrying on a general manufacturing, engineering and construction business.

Mayfield Coal Mine Toll Road & Electric Railway company, Ouray, Colo.; capital stock, $100,000; building an electric railway from a point on the Denver & Rio Grande railroad to the Mayfield coal mines in Ouray county, Colo.

Light, Heat & Power company (incorporated in W. Va.), Pittsburg, Pa.; capital stock, $500,000; constructing electric railways, telegraph cables and other works to which electricity may be applied; Caldwell & Caldwell, Wheeling, W. Va.

Petersburg Electric Light, Power & Water Works company, Petersburg, Ind.; capital stock, $10,000; to furnish electric light, power and water to said town of Petersburg, to the citizens thereof and the public generally; Geo. E. King, Petersburg, Ind.

The Columbus & Harrisburg Electric Street Railway company, Columbus, O.; capital stock, $1,500; constructing, leasing, acquiring, maintaining and operating a street railway to be run by electricity or other power, etc.; Hite & Courtright, Columbus, O.

White Manufacturing & Construction company, Bayonne, N. J.; capital stock, $100,000; making and selling articles for the equipment and use of steam, electric, cable, horse and other kinds of railroads and railways; Albert R. Genet, 132 Nassau street, New York city, N. Y.

Metal Construction & Bridge company, Chicago, Ill; capital stock, $100 000; to construct and equip steam, pneumatic, electric elevated, underground and surface railways, bridges and other iron and steel structures; Dennis Netling & Co., 184 Dearborn street, Chicago, Ill.

ELECTRIC LIGHTING.

The Fort Worth, Tex., Light & Power company will enlarge and extend its plant.

The Wilmington, Del., Street Railway company will erect an electric railway plant.

The city of Du Quoin, Ill., is advertising for proposals for an electric light franchise.

An application for an electric light franchise is pending in the city council of Panama, Cal.

It is claimed that the Benedictine Abbey of Fort Augustus is the first Roman Catholic church lighted by electricity in the British Isles.

The city of Tacoma, Wash., has offered the Light & Water company of that city $1,460,000 for the present waterworks and electric light plant.

The trustees of Port Angeles, Wash., have been considering the purchase of the electric light plant for $21,000. Considerable objection has arisen on the ground that the price was too large. The board finally adopted a resolution providing for the appointment of a committee by the president and secretary, the duty of which would be to bring a representative of some electric supply house to Port Angeles, to furnish the board with an accurate estimate of the cost of the local plant complete as it now stands.

The new Citizens' Light and Power company of Rochester, N. Y., has a large force of men at work excavating in the ruins of the Jefferson and Clinton mill property on Brown's race, destroyed by a naphtha explosion some years ago. A power house will be erected on the site. The work will be pushed through as rapidly as possible, and it is expected that it will be completed in the early spring. Water power and steam will both be used. The company will be ready to furnish light and power in the spring.

ELECTRIC RAILWAYS.

An electric road is projected at Ionia, Mich.

The Consolidated Cable company of Oakland, Cal., has been granted a franchise to use electricity on its line.

The Platte Valley Railway company will immediately survey an electric line from Denver to Bridgton, Colo.

F. W. Prescott & Co. of New York and Boston contemplate erecting an electric power plant at Columbus, Ga.

A company in which J. S. Clarkson and other Americans are interested has purchased a railway in and about the City of Mexico and will equip it with electricity.

A new line of electric railway is to be built from Newton Highlands to Newton Centre, thence to Newton, thence to Oak square in Boston. The capital stock is $100,000 and is already all subscribed.

Edward Hogaboom has let the contract for the grading on his electric railway at Hot Springs, Ark., which is projected to the Ouachita river, and work is to be began at once. The road will be five miles long.

The Provincial Legislature of Ontario, Can., will be asked for a charter for the Ontario & Niagara Electric Railroad & Power company which proposes to build and operate an electric railroad from Port Dalhousie via St. Catherines to the Niagara river near the Falls.

It is now reported that Paris, France, is to have an electric elevated road. The latest reports state that a syndicate of engineers has applied for the privilege of constructing an elevated railroad in Paris, to be operated by electricity. The proposed road will divide the city into two parts by a line running north and south. It will connect with all the important lines that already exist.

TRADE NEWS.

A "Pocket Catalogue" is being sent out by the Consolidated Electric Manufacturing company of Boston. It contains forty pages, and describes the various electrical supplies which this concern always keeps on hand. The work also contains some very good hints under the heading "Instructions to Purchasers," and also a short preface to the trade by the company's efficient general manager, Charles E. Bibber.

The Electric Appliance company, Chicago, is opening the season by pushing most energetically the sale of the New England double pole switches. This company has held the agency for this switch for the last year and has placed a large number of them, although they have always been high in price. Having, however, increased manufacturing facilities the Electric Appliance company is preparing for a largely increased demand.

A 3 per cent. semi-annual dividend has been declared upon the preferred stock of the Eastern Electric Cable company of Boston. This company's works cover over an acre of ground, and are complete in all departments. The cables and wires manufactured by this concern need no introduction to the electrical public. The company have orders on hand sufficient to keep it busy for some time to come. No little credit is due to President H. H. Eustis, and Treasurer Henry A. Clark for the continued success of this company.

Word has been received from Secretary H. D. Sisson, of the Electrolier Manufacturing company, of Pittsfield, Mass., to the effect that his company is now awaiting the return of its papers of incorporation from the secretary of state of New Jersey, which it expects are to be issued in a short time. This company has applied for incorporation with an authorized capital of $100,000, and it is said that already there has been stock enough subscribed to place the company on a strong financial basis. This company manufactures patent automatic adjusters for electric lamps, fans, bells, etc.

Messrs. Pease & Stow of New York announce that they are now prepared to receive orders for construction and electrical work of every description, having recently started a partnership business as electrical engineers, with office in the Bennett building, 97 Nassau street. Until recently Mr. Stow was connected with the engineering department of the New York office of the Mather Electric company. He is also well known to the electrical trade through his former connection as New York representative of the *Electrical Engineer*. Mr. Pease has had a wide experience, also, through his long connection with the Edison company.

The Shultz Belting company of St. Louis, Mo., exhibited and manufactured belting at the St. Louis exposition, and is responsible for the following incident, the result of a visit to that institution by one of the pupils of the Divoll school: A teacher in the Divoll kindergarten, giving her pupils instruction in astronomy and the movements of the planets, said to a little boy, "Johnnie, what causes the earth and moon to spin on their axes like a top as they do?" "That there strap," answered Johnnie. "What strap—what do you mean?" inquired the mystified teacher. "Why," said Johnnie, "I seen it on one of them picture cards down at the exposition." It was a picture of a strap running around the earth and the moon."

T. J. Murphy of New York, dealer in slate, is at present very busy filling orders. A recent sale to the Denver Consolidated Electrical company was 14 switchboards, 3 feet by 14 inches, made of Italian marble. A peculiar feature was that these boards are to be backed by slate. Among other orders for Italian marble is one for the Edison building and one for the Metropolitan Life Insurance building in New York. Switchboards of marbleized slate have also been ordered for the Empire theater, the American theater, and the Gerry building in New York. Mr. Murphy has secured the control of a new drill for slate and marble which enables him to do the best work on unfinished material. People ordering from a distance can send a sketch or a drawing and from it an order can be filled by Mr. Murphy most satisfactorily.

That the field for consulting and contracting electrical engineers is not confined to the cities of the first class like New York, Chicago, and Boston is shown by the fact that F. P. Little & Co. of Buffalo, N. Y., have been obliged to enlarge their establishment, increase their working force, and in order to provide for the increase in the business have formed a stock company, to be known as the F. P. Little Electrical Construction & Supply company. This company will continue the business of F. P. Little & Co., and will extend and enlarge it. During the last year this firm installed several important plants, and they have recently completed a number of isolated installations. Among these may be mentioned that of the stone opera house at Binghamton. This plant, including engines, dynamos, lamps, and wiring was installed complete. The theater was wired for 746 incandescent lamps. Thomson-Houston apparatus was furnished. In Buffalo plants were installed as follows: Barber Asphalt company, 5,000 watt Thomson-Houston dynamo, 65 incandescent and two Mosher arc lamps, wiring, etc; Joseph Metz, planing mill, 7 500 watt Thomson-Houston dynamo, Rice automatic engine, 100 16 candle power lamps, wiring, etc.; East Buffalo Iron Works, 20,000 watt Thomson-Houston dynamo, 38 16 candle power incandescent lights, 18 Mosher arc lamps, wiring, etc.; John C. Jewett Manufacturing company, wiring for 117 16 candle power incandescent lamps connected to central station; George V. Foreman's residence, 192 incandescent lamps, vulca ducts, etc.; Buffalo Furnace company, 25,000 watt Thomson Houston dynamo, 38 horse power Rice automatic engine, wiring

complete, 31 arc lamps of the Mosher pattern, 29 50 candle power and 21 16 candle power incandescent lights. Mr. Little says there has been a growing demand in Buffalo for arc lamps on incandescent circuits.

BUSINESS.

J. F. Dillont, formerly business manager of the *Electrical World*, has been appointed manager of the New York office of the Massachusetts Chemical company of Boston, with offices at 60 and 62 Broadway.

The Chas. F. Elmes Engineering Works, Chicago, have been removed to the corner of Morgan and Fulton streets. In the new establishment there is improved machinery, with facilities for handling larger work than heretofore. Among other tools there will be a 20 ton traveling crane and a 10 foot boring and turning mill.

The Valentine-Clark company, the Rookery, Chicago, dealers in poles and ties, reports a satisfactory year's business. This company's facilities for the coming year will be far better than those of last season, as it now has five branch yards at points which enable it to carry larger stock and to fill orders with greater promptness.

The Shultz Belting company of St. Louis has just issued the fifth edition of its little work of information on the selection and management of machine belting, with useful tables for determining the width of belt and horse power, etc. The first, second, third and fourth editions of this pamphlet were so highly appreciated that they were soon exhausted. The Shultz company has, therefore, doubled the issue of this edition. It has been enlarged, too, and contains more interesting information on belts.

Calendars for '93 are now the order of the day, and the electrical houses are not behind the times in this line. The Pennsylvania Electric Engineering company, Philadelphia, the Central Electric company, Chicago, the American Electrical Works, Providence, R. I., George Cutter, Chicago, not to forget the Postal Telegraph-Cable company—all these have submitted their best efforts to the trade. The race of the calendars has commenced, and it remains to be seen which one will secure "a place" over the office desk.

H. C. Adams, who, for the last few years has acted as Eastern manager for the Fort Wayne company, is now to become president of the Phillips Insulated Wire company of Pawtucket, R. I., with headquarters at 3941 Cortlandt street, New York. This company has adopted the letters "O. K." in white, with black background, as its trade-mark, and will continue to manufacture all kinds of insulated wire. Mr. Adams first entered the wire business in 1867, with Holmes, Booth & Haydens, and in later years was connected with the American Electric Light company. His wide experience with the former company will aid him greatly in his new departure.

Among recent changes of interest to the electrical fraternity is the transferring of the business of James W. Queen & Co., Philadelphia, to a stock corporation bearing the title "Queen & Co., Incorporated." The new company starts with a paid up capital of $600,000, which will be increased from time to time as may be required for the extension of its numerous interests, which, in addition to electrical measuring instruments, comprise scientific apparatus of every description. The incorporators and directors for 1893 are S. L. Fox, F. B. Fox, J. G. Gray, W. Biddle, Jr., J. G. Biddle and F. W. Stanwood, all of whom have been actively connected with the old firm. E. G. Willyoung continues as superintendent of the electrical laboratory.

Are you troubled by static electricity from your belts? is the leading question now put by the Chicago Rawhide Manufacturing company to prospective purchasers of belts for dynamos. It was about fifteen years ago that this company was organized by W. H. Preble, the present secretary and treasurer. Since that time Mr. Preble has paid especial attention to the details of the manufacturing end of the business, and how he has succeeded needs no better illustration than the substantial establishment, now the home of his company, at 75 and 77 East Ohio street, Chicago. A number of interesting reminiscences might be related of the company's early pioneer experience with rawhide belts for electric lighting service. It has been thirteen or fourteen years since the first belt of this material was used for electric lighting work in Chicago in M. C. Bullock's plant, and since that time the company has brought its goods to the front in a manner that leaves no doubt as to the advantage to be obtained from the use of rawhide. The Chicago Rawhide Manufacturing company handles almost every conceivable class of rawhide goods—in fact it makes anything in rawhide, from belt lacing and the smallest jeweller's lathe belt up to the largest main belt that may be demanded. Mr. Preble has been from the start an enthusiastic investigator into the needs of the trade, and his experience in the introduction of rawhide belting for dynamos leads his company to make some strong claims, two of which in particular are of peculiar interest to electrical men. It is generally admitted that accumulated static charges have in many cases had a great deal to do with very serious burn-outs in dynamo electric machinery. That this static electricity is in many cases due to the belting is also generally conceded. The belt, therefore, the company believes, that generates no static electricity, and therefore necessitates no arresting apparatus to carry off the frictional charge, is one that possesses an advantage not to be overlooked. Another peculiar advantage claimed for the rawhide belt is, that it runs clean in places where ordinary belts will blacken neighboring surfaces—as, for instance, a white-washed ceiling. These points, taken into consideration along with the feature of the adhesion of the rawhide belt, the company thinks, entitles it to the attention of buyers in the market for high-class goods.

ELECTRICAL PATENTS.

Issued January 3, 1893.

488,978. Brush Holder for Dynamos and Electric Motors. Ralph Ashley, Philadelphia, Pa.

A rack is attached to each brush bolder and adapted to be moved longitudinally by means of a spring actuated pinion, so that the brush is continually fed forward to compensate for wear.

488,993. Telephone Switch. John C. Francis, New York, N. Y.

The switch is designed to cut the generator out of circuit with the telephone line when the transmitter is removed from the hook. The hook rotates about an axis, and lies in a horizontal plane when the transmitter is hung up; when the transmitter is removed from the book a coiled spring rotates it upon its axis, thus actuating the switch.

489,000. Commutator for Dynamos and Electric Motors. Henry Groswith and Ralph Ashley, Philadelphia, Pa.

489,005. Elevator Indicator. Nelson Hiss, Baltimore, Md.

At each floor are placed indicators, terminals being provided adapted to be engaged by a brush carried upon the car and connected with one side of the battery so that as the car passes from floor to floor different circuits are closed to actuate the proper indicating devices.

489,046. Electric Arc Lamp. Elihu Thomson, Swampscot, Mass.

The invention comprises means for automatically cutting the lamp out of circuit when the carbon has reached the end of its stroke, or encounters any resistance which causes it to stop feeding. The carbon is attached to a band wound around the drum, and which is unwound to permit the descent of the carbon, when the carbon has ceased descending and the drum continues to unwind the band, the slack thus caused in the band acts upon one arm of a bell crank lever to open a contact, the contact being again closed when the carbon again begins to descend, thus drawing taut the suspending band.

489,052. Apparatus for Regulating Temperature. Joseph E. Watts, Lawrence, Mass.

489,065. Alternating Current Dynamo. James J. Wood, Fort Wayne, Ind.

The dynamo belongs to that type in which the armature is held stationary, while the pole pieces revolve. The armature comprises a series of inwardly extending coils of wire, their axes being radial to the axis of rotation of the field magnet; the field magnet poles are equal in number to the armature coils, the field magnet being energized by a single axial coil.

489,070. Armature for Electric Motors or Dynamos. Cornelius F. Daniels, Macon, Ga.

The armature is composed of separate bobbins wound with wire, each bobbin having a separate core, the bobbins surrounding the armature axis and being secured to it by end pieces and by wedged shaped clamping pieces between the outer portions of the bobbins.

489,071. Field Magnet for Electric Motors or Dynamos. Cornelius F. Daniels, Macon, Ga.

The field magnet consists of a number of pieces bolted or fastened together, each piece being wound separately with wire. After being placed together a layer of wire is wound around the whole, thus forming a field magnet in which the material of the core is in intimate relation with the winding.

489,075. Thermometric Indicator. Charles R. H. Erkens, Lakewood, N. Y.

489,097. Trolley Wire Support. George H. Scranton and Lorenz Spillman, Columbus, O.

489,098. Testing Apparatus for Multiple Switch-Boards. Charles E. Scribner, Chicago, Ill.

489,099. Testing Apparatus for Multiple Switch Boards. Charles E. Scribner, Chicago, Ill.

A generator is connected with the telephone lines and adapted to send slowly alternating or undulatory direct currents over the lines, while in circuit with each operator's telephone is included a rheotome adapted to render the undulations supplied by the generator audible. In the operator's telephone circuit is also included a circuit changing device, which is adapted to change the direction of the current through the rheotome; when a line tested is free current will pass through the rheotome and the operator's telephone in whichever direction the current is flowing, so that a continuous hum will be heard by the operator; when, however, the line is busy current will pass through the rheotome only when the circuit is closed in one direction, so that the operator will hear an intermittent buzz, and will know that the line is busy.

489,100. Test Circuit for Multiple Switch-Boards. Charles E. Scribner, Chicago, Ill.

A retardation coil is provided in a ground branch with a test battery for each of the telephone lines, a cord switch, and listening and calling key, and the operator's telephone and switching devices are so arranged that the operator on raising the plug in response to a subscriber's call brings her telephone into circuit, and throws on the branch containing the retardation coil and battery to make the line immediately test busy.

489,101. Means for and Process of Separating Metals from Ores. Charles E. Seymour, Lake Geneva, Wis.

489,113. Operating Device for Bridge Gate. Edward Zaremba, Chicago, Ill.

489,114. Electric Metal Working. Craig R. Arnold, Sharon Hill, Pa.

The metal working device consists of a carbon pencil in circuit with a generator, and adapted to be first brought in contact with the metal to be operated upon, and then to be withdrawn a short distance to form an arc, whereby the heating effect is produced. In circuit with the carbon pencil is placed a choking coil, the counter electromotor force of which, when the carbon pencil is first touched to the metal, will be in such a direction as to oppose the passage of the current from the carbon pencil to the metallic plate, thus preventing a short circuit when used upon a circuit of low resistance. When the carbon is withdrawn from the plate the counter electromotor force of the choking coil will be in such a direction as to assist the passage of the current from the carbon to the metal, thus rendering the establishment of the arc certain.

489,115. Secondary Battery. Craig R. Arnold, Sharon Hill, Pa.

The invention is an improvement over secondary batteries in which the electrodes are separated by sand, and consists in substituting for the sand small pieces of lead, as, for instance, shot, which serve the double purpose of separating the individual plates, and of being themselves active material.

489,150. Electric Lantern. Adam Kell, McKeesport, Pa.

489,158. Incandescent Lamp Socket. George C. H. Foster, Bridgeport, Conn.

489,161. Electric Meter. Heiorich Illig, Bockenheim, Germany.

489,172. Lamp Support. Curtis N. Wilcox, Brooklyn, N. Y.

489,179. Automatic Switch for Trolley Tracks. William H. Brodie, Brooklyn, N. Y.

489,185. Commutator Brush Holder. Charles F. Goodrich, Chicago, Ill.

489,186. Storage Battery Electrode. George W. Harris, New York, N. Y.

The electrode is built up from alternate strips or sheets of conducting and absorbent non-conducting material; each alternate sheet of conducting material extending laterally over the opposite edge of the intermediate absorbent material, and finally uniting the extending edges together in each instance in one integral face.

489,207. Fender for Electric or Other Cars. Martin S Starkweather, Boston, Mass.

489,212. Temperature Indicator. James Bartlett, Toledo, O.

489,215. Valve for Fire Alarm Whistles. Gilman W. Brown, West Newbury, Mass.

489,216. Amalgamator. Hugh Calhoun, Hot Springs, and Aaron M. Beam Bear.

The method of amalgamation consists in mingling with the pulp a proper quantity of mercury, and stirring the mass in a suitable receptacle subject to the heat of a water bath, and to the action of an uninterrupted current of electricity of constant direction.

489,234. Electric Railway Trolley. Jean Reutlinger, St. Louis, Mo.

The flanges of the trolley wheel are provided with radially extending teeth so that the trolley may pass a transverse suspending wire passing immediately beneath the trolley wire.

489,237. Fire Alarm. William J. Schweiger, New York, N. Y.

489,249. Electrical Measuring Instrument. Johannes H. F. Gorges, Berlin, Germany.

The instrument is designed for measuring currents of large volume, and consists of a conducting bar having attached to it a portion of magnetic material provided with a semicircular cavity in one end; an armature is mounted upon a shaft, and moves concentrically with the inner surface of the cavity when influenced by a current transmitted through the conducting bar. An index pointer is connected with the armature, and is adapted to move over a scale.

489,266. Telephone Switch Appliance. Parnell Rabbidge, Sydney, New South Wales.

The switch appliance is designed for telephones, and is adapted to switch the current from the ringing circuit to the calling circuit, and vice versa. A small closed receptacle filled with mercury and provided with terminals in its ends is attached to the receiver, and when the mercury rests in one end of the receptacle due to the position of the receiver circuit is closed through the talking circuit, when, however, the receiver is given another position the mercury flows to the other end of the receptacle to close the ringing circuit, thus opening the talking circuit.

489,302. Dynamo Electric Machine and Motor. Walter T. Goolden and Llewellyn B. Atkinson, London, England.

An air tight non-magnetic casing surrounds the armature, and a jointed supplemental portion of the casing surrounds the commutator and brushes so that access may be had to the commutator without removing the main casing.

489,277. Electro Magnet. Richard Varley, Jr., Englewood, N. J.

The method of winding the electro-magnet forms the principal feature of the invention, and consists in winding side by side an insulated wire, and a bare wire, the bare wire thus lying between the insulated wires is properly insulated, and being of a less diameter than the exterior diameter of the insulated wire it lies between the convolutions of the larger wire, thus occupying less space than it would if it were provided with an insulation.

489,312. Fire or Burglar Alarm. Elzear La France, Worcester, Mass.

489,315. Secondary Battery Electrode. Auguste M. Michel, Paris, France.

The negative element of a lead zinc accumulator consists of a support carrying an amalgam rich in mercury.

489,316. Manufacture of Accumulator Plates. Auguste M. Michel, Paris, France.

The active material for the plates is made by forming an alloy of lead and some other metal, such as zinc, then disintegrating or reducing the alloy and eliminating the metal alloyed with the lead, and leaving the latter in a porous distended condition, and finally compressing the lead into the desired form.

489,318. Electro Magnetically Heated Receptacle. Willis Mitchell, Malden.

The receptacle consists of a hollow body of magnetic material having studs of similar material formed thereon; helices of wire are wound upon the cores and connected in an alternating current circuit, the heating effect being derived from the resistance of the wire, and the effect of hysteresis in the cores.

489,330. Electric Elevated Railway. Andrew L. Rutter, Washington, D. C.

A double track is suspended between towers provided along the roadway, and each car is provided with two trucks, each provided with a motor, and running upon the track. The car body is of cylindrical or cigar-shape, and is suspended beneath the track from the trucks.

489,364. Combination Fuse Box. William F. Bossert, Utica, N. Y.

489,422. Underground Conduit for Electric Railways. Charles P. Tatro, Spokane, Wash.

489,423. Electric Time Alarm. Jacob P. Tirrell, Boston.

489,424. Valve Controlling Clutch. Jacob P. Tirrell, Boston.

489,435. Telegraphy. Leroy P. Hotchkiss, Oak Park.

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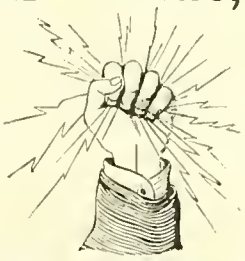

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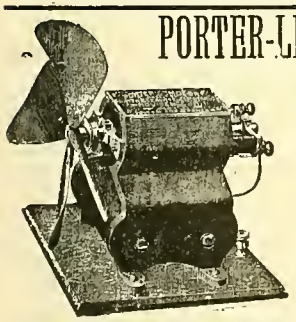

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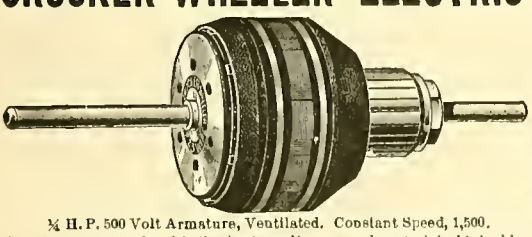

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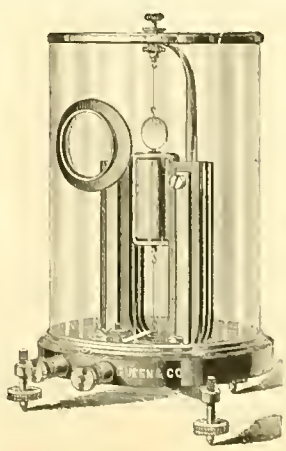

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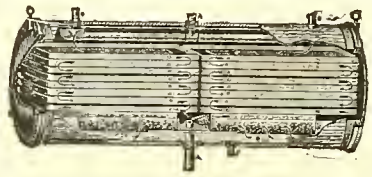

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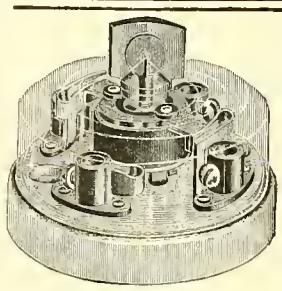

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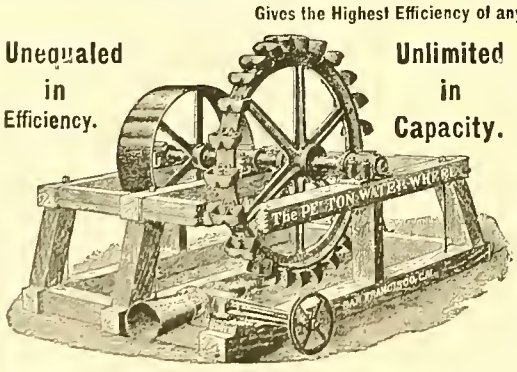

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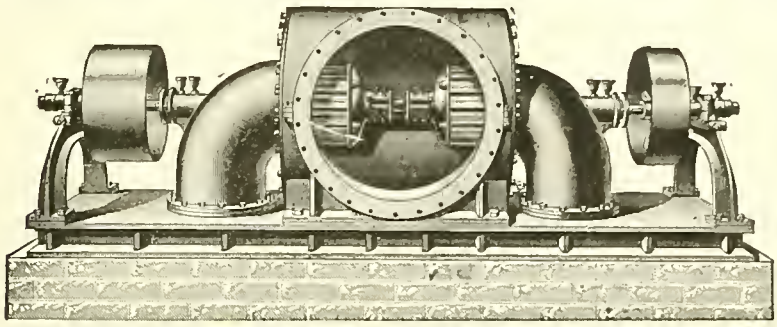

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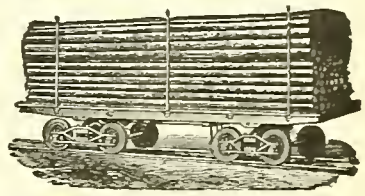

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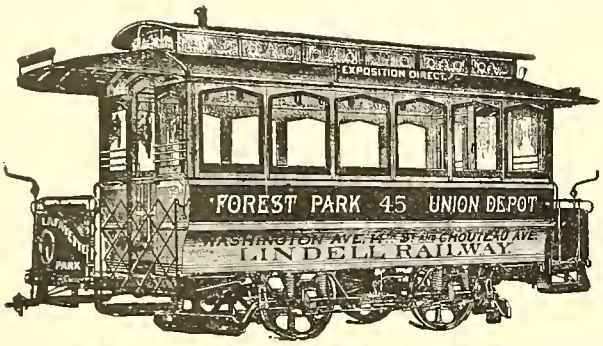

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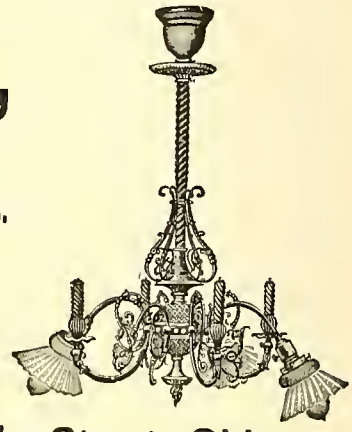

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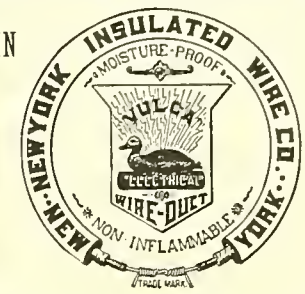

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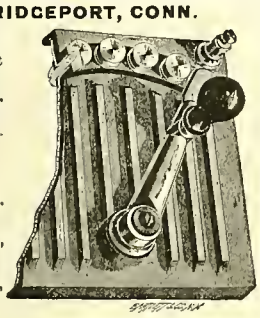

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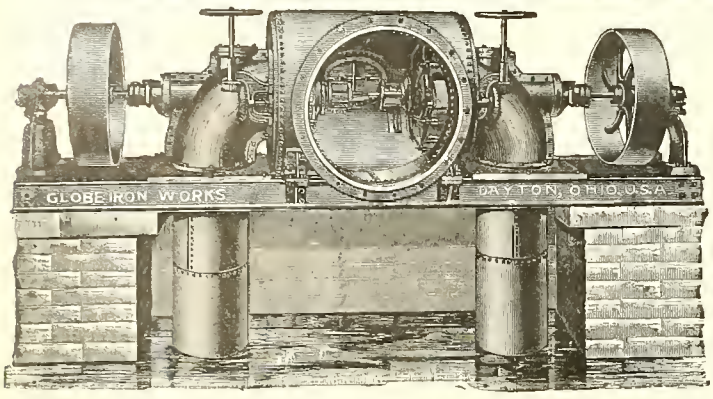

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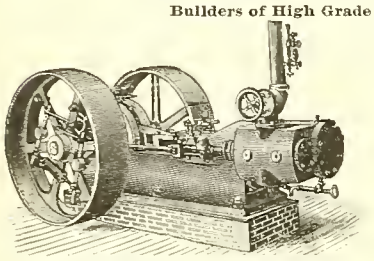

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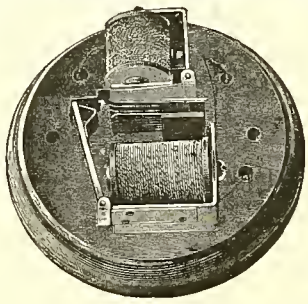

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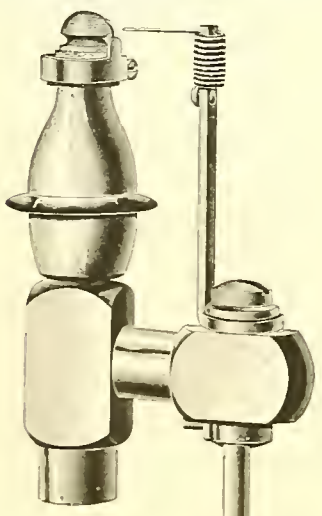

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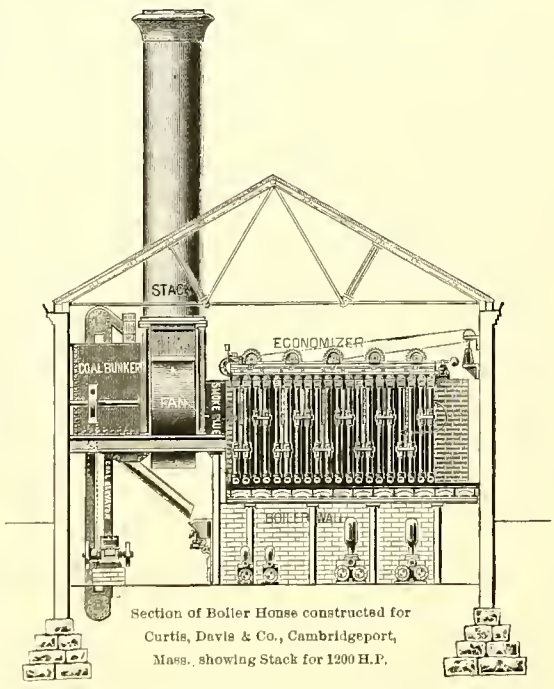

Section of Boiler House constructed for Curtis, Davis & Co., Cambridgeport, Mass., showing Stack for 1200 H.P.

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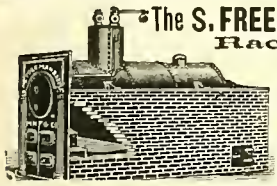

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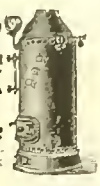

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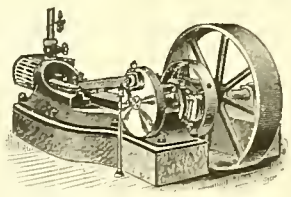

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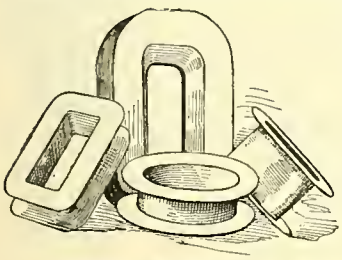

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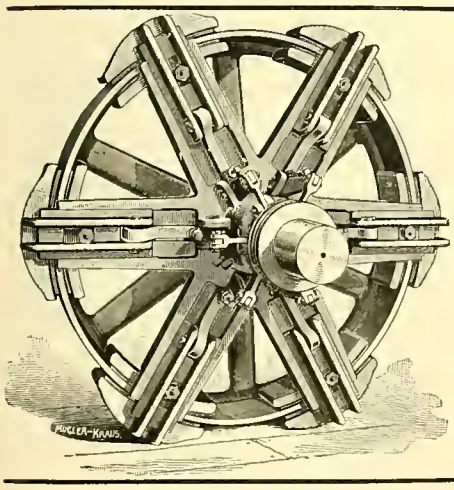

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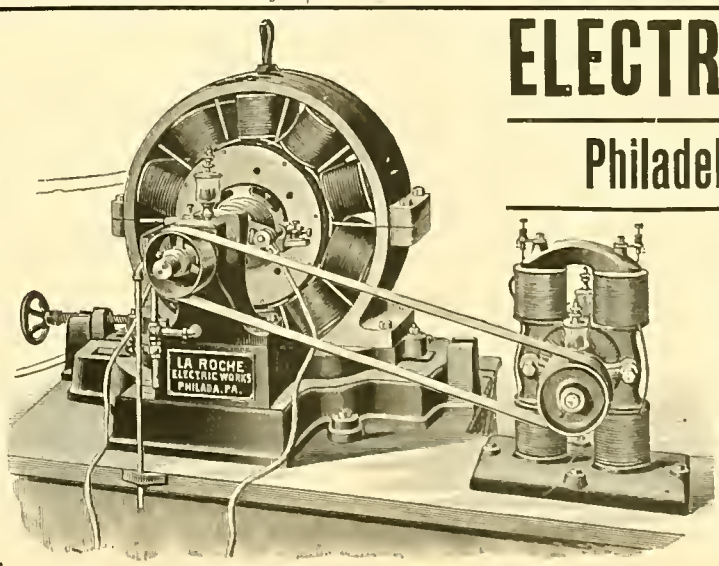

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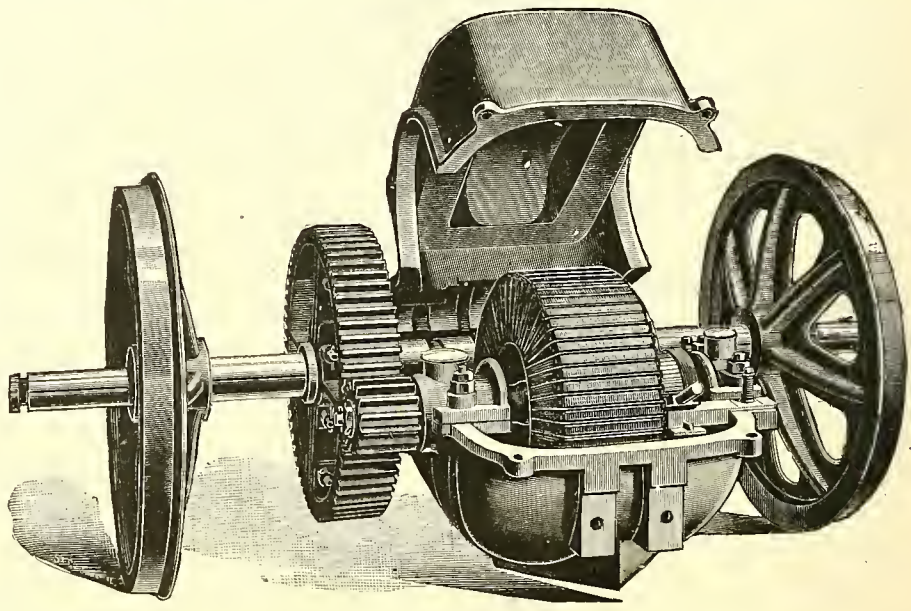

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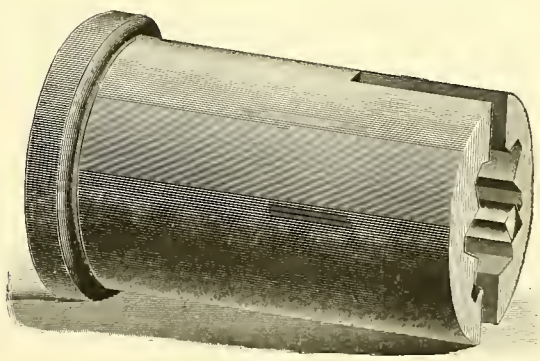

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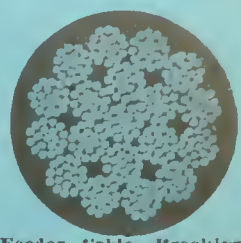
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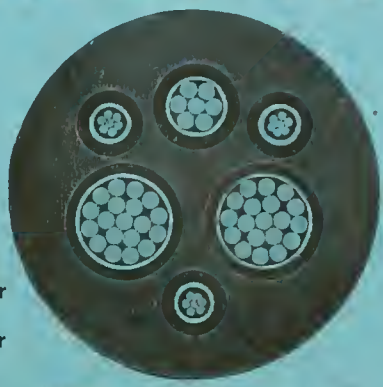
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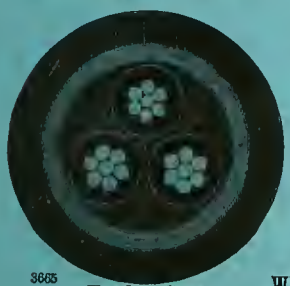
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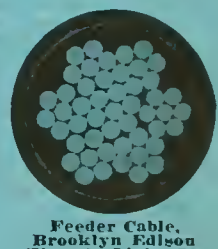
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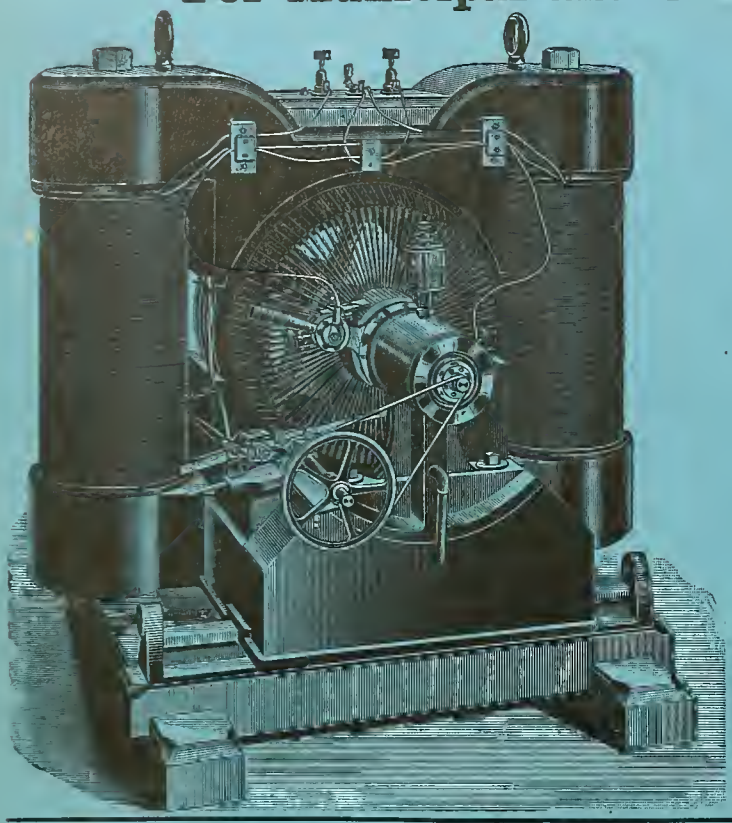

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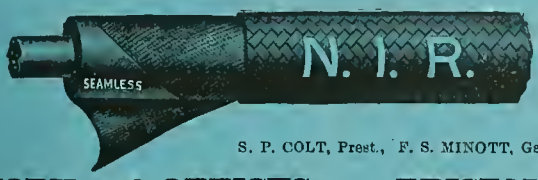

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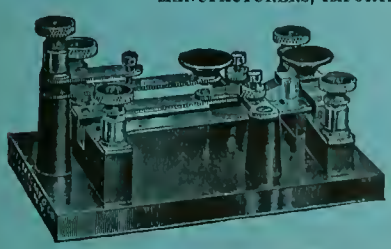

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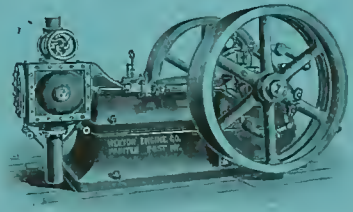

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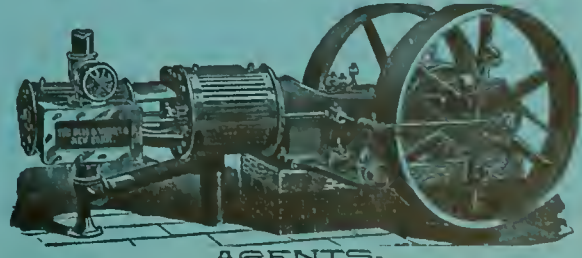

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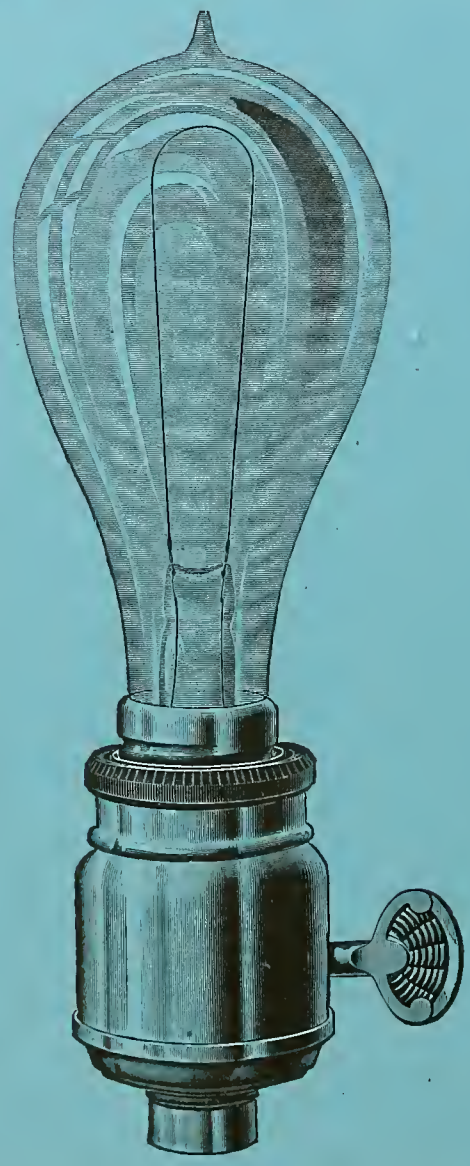

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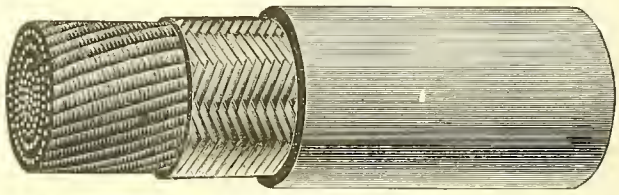

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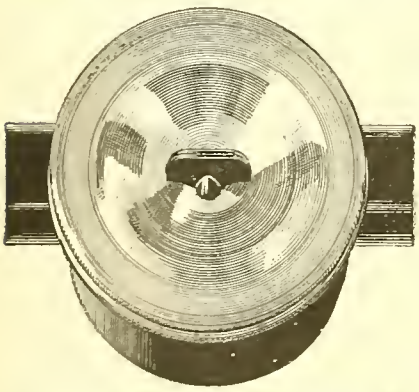

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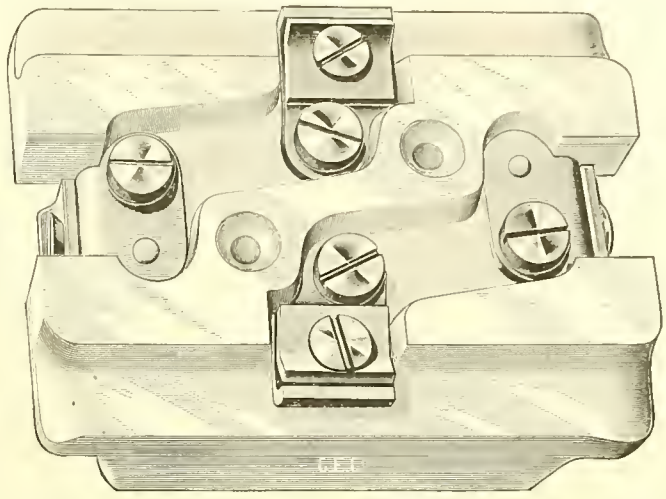

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We have been doing some fine work that required extra good insulation, which from the character of the work was difficult to secure with the ordinary method. We tried Insullac and it filled the bill, and enabled us to do the work easily, cheaply, and with the very best results.

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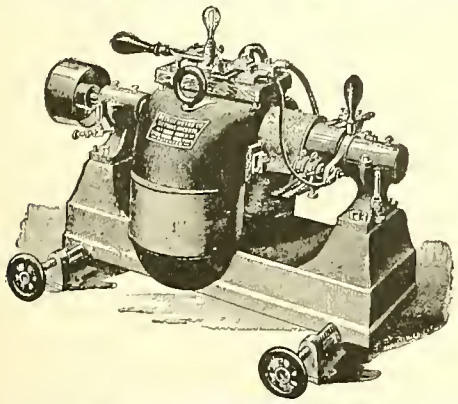

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These mines are of ancient discovery, and were worked with great profit for a long period, being only abandoned on account of political troubles before and after the War of liberation.

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These mines are so richly endowed with auriferous material, from the easily-worked sand, gravel, and dirt (carrying virgin dust and nuggets), to the fissure veins of free milling quartz, that when properly equipped a profit of ten thousand dollars ($10,000) a day, or over three million dollars ($3,000,000) annually is a very low and conservative estimate.

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It is proposed to organize this property on a basis of five million dollars ($5,000,000), upon which there can be dividends earned of 60 per cent. or more, and the parties furnishing the original capital, in small or large sums, for this organization, which will be about twenty-five thousand dollars ($25,000), will be let in on a basis of two and a half cents (2½c.) on the dollar, with the privilege of purchasing pro rata at five cents (5c.) on the dollar, a sufficient amount to give them a controlling interest if they so desire.

There is also the right of prior possession to double the amount of contiguous land.

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An experienced miner who has been over and thoroughly examined the property, says more gold is there than in the entire State of California, while another says so great is the evidence of mineral wealth I sometimes doubted my own sanity, and were I to tell California and Colorado miners even a tithe of what I actually saw, I would be branded as a foolish liar or raving maniac.

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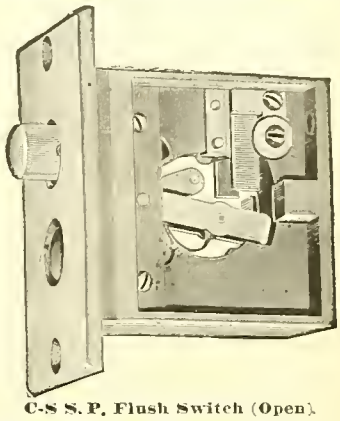

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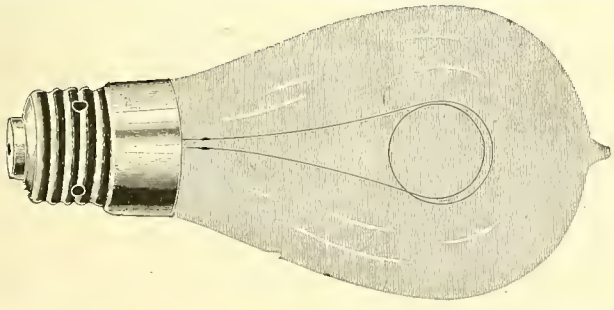

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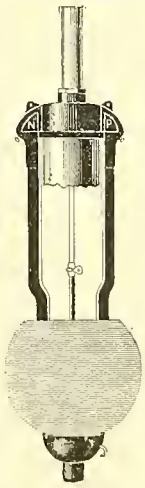

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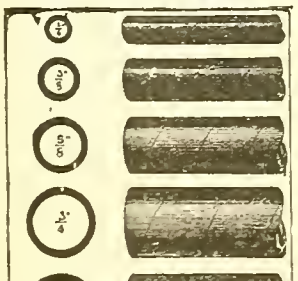

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TO THE USERS OF INCANDESCENT LAMPS:

The shipment of our new stopper lamps will begin early in January. In making this announcement, and in quoting prices, we take pleasure in giving particulars which will indicate some of the many advantages the users of our apparatus will enjoy.

First. The new lamps are made in separable parts so that the carbon burners may be replaced, and the glass parts used repeatedly, and their bases being moulded of uniform size to fit a specially designed socket, the lamps are neater in appearance than the all glass-globe form.

Second. The carbon burners will be preserved by an attenuated atmosphere of nitrogen, and their candle-power maintained more nearly constant than heretofore by means of a recent important discovery.

Third. Special sockets of neat design will be employed for these lamps, and special fittings will be supplied at five cents each, which will adapt any of the forms of sockets now in use to receive the new lamps, thereby bringing about exact uniformity in lamp bases.

Fourth. By reason of the manufacture of the lamps by special machinery and improved methods, by the use of nitrogen for preserving the carbons, and by means of pumping and charging apparatus recently perfected, **WE HAVE BEEN ABLE TO SO REDUCE THE COST OF MANUFACTURE AS TO FIX OUR PRICES FOR 8, 10 and 16 CANDLE POWER LAMPS AT 30 CENTS EACH, SUBJECT TO A DISCOUNT OF 10 PER CENT. TO OUR CENTRAL STATION CUSTOMERS,** and to others from 2½ per cent. upward, according to quantity, **WITH AN ALLOWANCE OF 10 CENTS FOR EVERY BURNED-OUT LAMP RETURNED UNBROKEN** to any one of our factories, making the net cost **OF RENEWALS FOR THE 8, 10 and 16 CANDLE POWER LAMPS 17 CENTS** to our central station customers. For 20 and 25 candle power lamps the prices will be 35 cents each, subject to the same discount and allowance for burned out lamps.

By long and careful tests, and by the use of a large number of these lamps in our works, we have demonstrated that the new lamp will have greater advantages for users than the Edison lamp or any of those heretofore upon the market.

The importance of the improvements in manufacture by which we have been enabled to offer these lamps at so low a price will be appreciated by all users who are aware of the constant deterioration in the carbon burners, and of the fact that the real commercial efficiency of a lamp is its average efficiency. With a constant amount of electric current the ordinary 16 candle power lamps rapidly fall below 10 candle power from deterioration of the carbon, when they must be renewed; and it results from this, that the users, with cheaper lamps will get from 15 to 20 per cent. more light from a given expenditure of electricity by a more frequent renewal of lamps than is now customary. Thus the low cost of the lamps may be made to add to the revenue of a lighting station in one of two ways, viz., either by giving a greater lighting capacity at the present cost of lamp renewals, or by actual saving in the cost of lamps with renewals made at the present period of renewal.

The problem of manufacturing a sufficient number of lamps to supply the entire demands expected from the users of electric light is a difficult one to meet quickly. We are preparing to turn out from 15,000 to 20,000 lamps daily, and in addition to this to renew the carbons in returned burned-out lamps to any extent that may be required. During the month of January we expect to be able to take care of all of our customers who must have the new lamps, and rapidly thereafter to fill all the orders with which we may be favored.

We are also contemplating the erection, as the business develops, of "renewal stations" in all large cities such as New York, Boston, Philadelphia, Chicago, Cincinnati and St. Louis, thereby reducing the cost of shipment and return of lamps for renewals, and still further reducing the net cost of the lamps to our customers.

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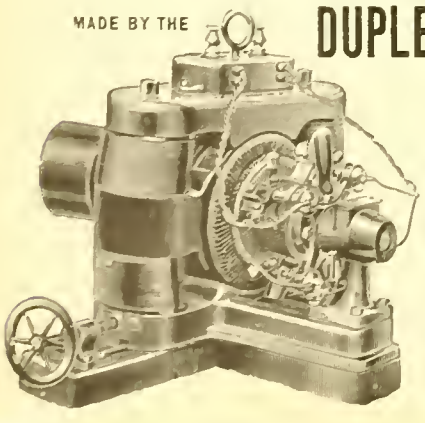

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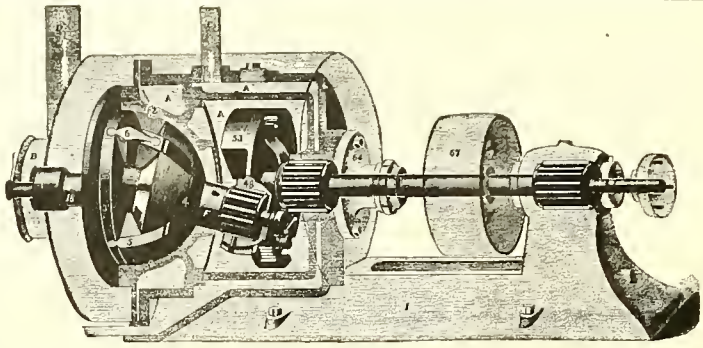

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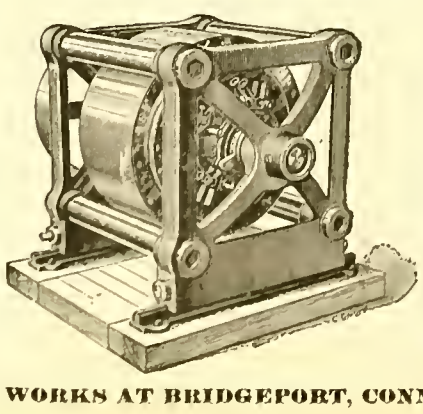

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WORKS AT BRIDGEPORT, CONN.

Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, JANUARY 21, 1893. No. 3

The Chicago Electric Club.

"To promote social intercourse, to diffuse knowledge among those interested in electrical matters, and to provide members with the conveniences of a club house."

This paragraph from the constitution and by-laws of the Chicago Electric club explains in a few words the purpose of an organization which now stands to the front as one of the many establishments that may be pointed to as illustrating the extraordinary growth of electrical industries in the West.

How well the club has succeeded in its work, and how it has made itself an organization of strength and power in the community, is a familiar story to those acquainted with electrical matters. Resident members find the club a means of social intercourse which tends to further and make pleasanter many business relations. Combining, as it does, a scientific element with the commercial features, the club's influence, which has broadened through the publication of its scientific and practical papers, is widespread, and is appreciated by both theoretical and practical men.

It was in 1887, when electricity was in reality "in its infancy"—and especially so in the West—that the idea of forming an electric club in Chicago was first considered. In the spring of that year several gentlemen prominently identified with the electrical interests of Chicago held a number of informal conferences to discuss the advisability of organizing such a club, and it was finally decided that the prospects of the new venture were sufficiently encouraging to warrant the step. Application was made to the secretary of the state of Illinois for a charter, and on May 20, 1887, the club received its first papers.

The charter was issued to the following named incorporators: Charles J. Van Depoele, Franklin S. Terry, Charles A. Brown, William J. Buckley, Aaron K. Stiles, W. J. Armstrong, W. A. Kreidler, F. G. Beach, John P. Barrett, Charles D. Shain, B. E. Sunny and Joseph Uhrig.

Following the receipt of the articles of incorporation several meetings were held in the Lakeside building, where a further organization of the club was effected and officers were elected as follows: President, General Aaron K. Stiles; vice-presidents, C. A. Brown, John P. Barrett, B. E. Sunny and F. G. Beach; secretary, W. A. Kreidler; treasurer, Franklin S. Terry; managers, C. A. Brown, chairman, F. S. Terry, W. A. Stiles, W. A. Kreidler, B. E. Sunny, E. B. Chandler, G. A. Beedle, H. Ward Leonard, W. J. Armstrong, W. J. Buckley, John P. Barrett, Chas. D. Shain, William J. Lloyd, F. W. Cushing, Geo. H. Bliss and S. A. Treat.

The first regular meeting of the club after permanent organization had been effected was held at the Grand Pacific Hotel on Thursday evening, June 2, 1887. A week later another meeting was held in the same hotel, at which twenty-nine members were present, and it was decided to hold a banquet at the Grand Pacific on the evening of June 18, 1887. To this feast, prepared under the direction of H. Ward Leonard, J. L. Barclay and C. A. Brown, forty-eight members and guests sat down. A pleasant evening was passed, and all pledged themselves to do all in their power to insure the success of this, the fourth electrical society started in Chicago.

On Monday evening, July 11, 1887, the club met for the first time in what might be called its own home. The quarters were in a large office room on the first floor at 225 Dearborn street. To quote a gentleman who was instrumental in the formation of the club: "The club did not have the room every day or every night. The room happened to be unoccupied, and we were given the privilege of using it for about a quarter of the usual rental. We occupied it one night every week. Sometimes we had meetings when we had a quorum present, and then again we failed to meet." Such were the first quarters of the Chicago Electric club, and here it was that the now prosperous organization began its term of usefulness.

No attempt was made, however, to decorate or otherwise improve the Dearborn street quarters, for every one felt that they were only a sojourning place. It was here, though, that the first of the club's long series of valuable scientific papers was read. It was the production of C. C. Haskins, and the subject was "Underworked Territory."

Owing to the hot weather and the absence of many of the members who were attending the electrical conventions then in progress in the East, the next meeting of the club

FIG. 1. CHICAGO ELECTRIC CLUB.

1. Entrance to the Club Rooms. 2. Lecture Room and Parlor. 3. Perspective View through the Suite.
4. Library. 5. Card Room. 6. Billiard Room.

was not held until seven weeks later—Monday, August 22, 1887. But from that time on the organization grew steadily. It was not long before it became evident that better accommodations would have to be secured, and a committee was appointed to select a more desirable location. The committee's work resulted in the removal of the club to quarters in a building at 122 Clark street, and it was on the evening of October 17, 1887, that the first scientific meeting was held in these new rooms. It was at the Clark street rooms that the first effort was made to develop the social features of the organization. A kitchen was established, and the serving of a midday meal did much toward bringing the members together and creating the sociability so necessary to the life of the club. Billiard tables were put in the new rooms, and a small library started, and these, too, constituted their share in the promotion of sociability. Although the new quarters on Clark street were satisfactory in many respects, there were still a number of undesirable features. To be sure, during 1887 many members had been gained and much advancement had been made. Thirteen regular meetings had been held, one banqnet had been given, and the club had done most excellent work in disseminating technical knowledge. Still many felt that, although it was getting on its feet, so to speak, the club was not yet what it should be; and this feeling, coupled with the growing dissatisfaction over the location of the rooms, led the club again to cast about for a home still better adapted to its needs.

The next step was the removal to 103 Adams street, and the quarters there were first occupied in April, 1889. With elevator service, handsomely furnished rooms on two floors, including a lecture room, reading room, dining and billiard rooms, to say nothing of the establishment and operation of the club's restaurant service under its own supervision—all this indicated a steady and healthy growth, and gave the members conveniences that placed their organization in the same rank as other down town clubs. It was in the Adams street quarters that Chicago electricians first began thoroughly to appreciate the fact that a membership in this organization gave a technical man a standing not to be obtained on the ontside.

It was about this time that Chief Barrett of the department of electricity at the World's Fair extended an invitation to the club to present to him the names of three electrical engineers, from which he could select one to recommend to Chief of Construction Burnham of the World's Fair to be his special electrical engineer. This was indeed a high compliment to the club, and was a public recognition of the standing of the organization.

Changes are not always a sure indication of advancement, bnt in the case of the movements of the Chicago Electric club every change of quarters marked a step in the prosperity of that institution. After Chicago was made the World's Fair city, it became evident to the club that something would have to be done toward securing even better facilities than those afforded by the Adams street rooms. The impetus which the fair had given to electrical work of all kinds in and about Chicago, and the increase of visitors to the city even at that early date, brought about by this activity, were taken as indications of what would be required of the club during the time the exposition was in progress. It was apparent to every member that it would he incumbent upon the Chicago Electric club to entertain and furnish a resting place for electrical men from all over the world. Electrical engineers and men otherwise interested in the industry would flock to Chicago during the six months of the exposition, and it would not only be the duty bnt the pleasure of the fraternity in Chicago to entertain these visitors. Bnt it was necessary to have far more extensive and better equipped quarters than were the Adams street club rooms. This problem of how and where to secure a location that should be centrally located and at the same time possessed of the other most necessary requisites proved to be one of difficult solution. After a thorough canvass of the business district—in the belief that it would be unwise to locate elsewhere—it was decided to rent the second floor in a building on the northeast corner of Monroe and Clark streets, and virtually build club rooms by partitioning off the space secured according to the peculiar requirements of the organization. That this selection was a wise one is the testimony of almost every resident member. Situated as it is, in the very heart of the city, within easy walking, distance of the hotels, theaters, and main railway stations it has been conceded that it would have been a very difficult task to have secured more convenient accommodations.

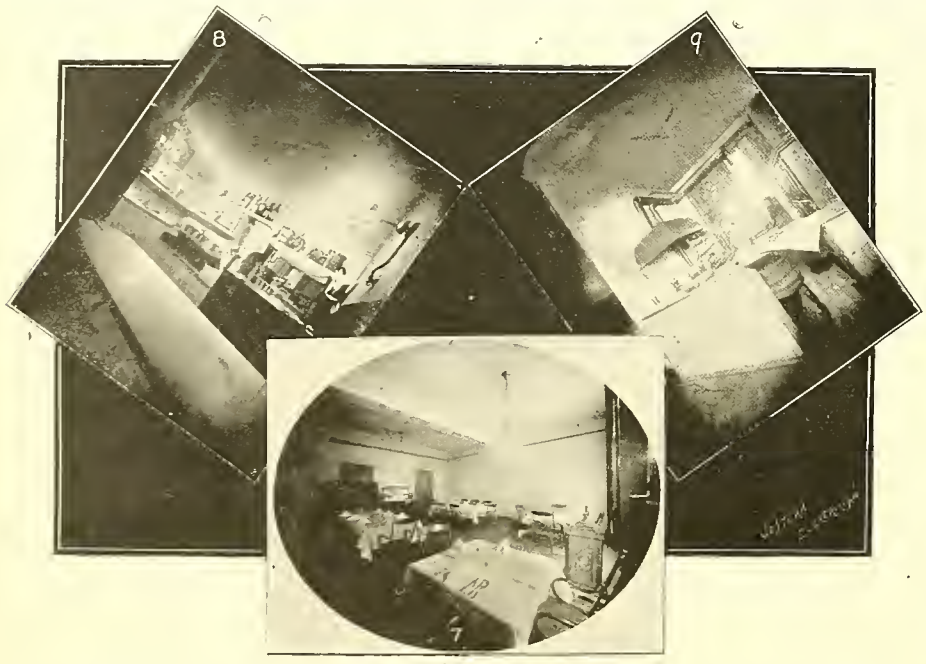

FIG. 2. CHICAGO ELECTRIC CLUB.

7. Dining Room. 8. Buffet. 9. Kitchen.

How well, too, the committee did its work of laying out the new quarters can only be appreciated by those availing themselves daily of the club's accommodations. The accompanying illustrations, however, will give a fair idea of the tastefully arranged rooms.

The club's membership at present numbers 188—135 resident and 53 non-resident members. Following are the names of members who have been prominently identified with the club:

C. G. Armstrong, consulting electrician for Adler & Sullivan.
B. J. Arnold, consulting engineer, General Electric company.
F. B. Badt, manager power and mining department, Geoeral Electric company.
E. Baggot, gas and electric light fixtures.
G. C. Bailey, manager J. A. Roebling's Sons Co.
T. P. Bailey, manager railway department, General Electric company.
Force Bain, president Bain Electric Manufacturing company.
J. P. Barrett, chief of the department of electricity, World's Fair.
F. G. Beach, general superintendent Central Union Telephone company.
G. H. Bliss, electrical expert.
W. J. Buckley, special agent Fort Wayne Electric company.
W. E. Baker, general manager Western Intermural Railway company.
J. W. Chalmers, vice-president and treasurer Fraser & Chalmers.
E. B. Chandler, western agent Gamewell Fire Alarm & Telegraph company.
R. C. Clowry, vice-president and general superintendent Western Union Telegraph company.
Seymour Coleman, capitalist.
F. W. Cushing, capitalist.
Geo. Cutter, electrical specialties.
F. E. Degenhardt, western manager Standard Under ground Cable company.
Alex. Dow, electrician Brush Electric company.
L. A. Ferguson, electrical engineer Chicago Edison company.
C. K. Giles, Giles Bros., jewelers.
E. R. Gilman, president Great Western Electric Supply company.
H. K. Gilman, general manager Great Western Electric Supply company.
J. H. Goehst, superintendent of construction Chicago Edison company.
F. S. Gorton, manager and treasurer Chicago Edison company.
Elisha Gray, electrician and inventor.
C. E. Gregory, trader.
C. C. Haskins, city electric light inspector.
W. I. Hitt, secretary Chicago Copper Refining company.
E. E. Keller, superintendent for the Westinghouse company, World's Fair.
Alex. Kempt, capitalist.
M. A. Knapp, manager Knapp Electrical Works.
J. L. Martin, central station department General Electric company.
W. H. McKinlock, president Central Electric company.
C. T. Page, secretary Englewood Electric Light company.
F. W. Parker, patent lawyer.
W. B. Pearson, W. B. Pearson & Co., engines.
D. P. Perry, general manager Standard Electric company.
R. H. Pierce, electrical engineer, World's Fair.
Henry R. Post, zinc and lead merchant.
J. K. Pumpelly, electrician and inventor.
F. Sargent, mechanical and electrical engineer, World's Fair.
J. H. Shay, Munson Belting company.
A. Schillinglaw, electrician Union Stock Yards.
E. A. Sperry, electrician General Electric company.
A. K. Stiles, capitalist.
B. E. Sunny, western manager General Electric company.
Wm. Taylor, Taylor, Goodhue & Ames.
F. S. Terry, manager Electrical Supply company.
A. S. Terry, treasurer Sunbeam Incandescent Lamp company.
H. H. Wait, Western Electric company.
H. S. Walker, western manager Taylor Manufacturing company.
C. H. Wilmerding, superintendent Chicago Arc Light & Power company.
Ben. Williams, manager State Mutual Life Insurance company.
Chas. Wirt, electrician Electrical Supply company.
M. M. Wood, electrical engineer.
S. A. Barton, president Brush Electric company.
W. L. Candee, treasurer Okonite company.
C. A. Daigh, vice-president and manager National Electric Manufactnring company.
Thos. A. Edison, inventor.
S. D. Greene, General Electric company.
A. L. Ide, A. L. Ide & Son.
Samuel Insull, president Chicago Edison company.
C. H. Jackson, vice-president Standard Underground Cable company.
C. Kammeyer, electrical engineer.
R. T. McDonald, general manager Fort Wayne Electric company.
G. M. Phelps, publisher *Electrical Engineer*.
Frank B. Rae, electrical engineer.
B. Rorison, secretary Fort Wayne Electric company.
C. D. Shain, district manager Siemens & Halske Electric company.
Geo. B. Shaw, congressman.
M. W. Simons, capitalist.
J. B. Wallace, general manager Electrical Supply company.
E. R. Weeks, general manager Kansas City Electric Light company.
E. F. Williams, Williams Engine company.
R. N. Baylies, attorney at law.
S. A. Douglas, manager Brush Electric company.
J. H. Gates, Siemens & Halske.
R. I. Sloan, chief engineer South Side Rapid Transit company.

With its present list of 188 members, which includes such names as Thos. A. Edison, Elisha Gray, John P. Barrett, etc., the Chicago Electric club feels that its record is one of which it is fairly entitled to be proud.

In concluding this sketch of an institution that will without doubt be a familiar one to every electrical man that visits the World's Fair, it may not be amiss to call attention to a circular which the club is now sending abroad over the names of a committee on "special non-resident membership." This circular reads in substance as follows:

"The Chicago Electric club has been the recipient of many inquiries as to the requirements of membership during the World's Columbian Exposition.

"These letters intimated that many non-resident citizens of the United States and many foreigners would prefer to be entitled to the privileges of the club rather than be considered guests only.

"The club is located in the center of the city, within a few minutes' walk from all the lending hotels; has all club conveniences, and has always been the headquarters of all electrical visitors to the World's Fair city.

"While the Chicago Electric club, of course, expects to have its hospitable quarters open to the whole electrical fraternity of all nations, and invites them most cordially to consider the club quarters their home during the exposition, it is in view of the facts stated above that the undersigned committee asks you to sign inclosed application for 'special non-resident membership' during the World's Columbian Exposition if you should so desire.

"The committee has deemed it advisable not to charge any entrance fee, but to collect only a 'special non-resident membership fee' of $10, payable in advance."

All communications relative to this "special non-resident membership" should be addressed to C. Villeneuve, manager of the Chicago Electric club, corner of Clark and Adams streets, Chicago.

Electricity at the World's Fair.

The diagrams given herewith, Figs. 1 and 2, show the allotment of space in the electricity building at the World's Fair. Comparatively few exhibitors will have space on the ground floor, where the large companies will make large and imposing displays. The most striking "show" feature will be the glass pagoda of the Phoenix Glass company in the center of the building. This will be seventy or eighty feet high, of graceful outline, and will scintillate with incandescent lights. Surrounding this central space on all sides is the allotment of the General Electric company, whose display, of course, will be one of the principal features of the building. This company is also the largest contributor to the service lighting of the building. The leading domestic manufacturers of electrical machinery and several foreign countries will also have exhibits on this floor. The Bell Telephone company will make an elaborate display, and is now erecting a fine structure in its space in the southern end of the building. The Western Electric company has adjacent space, and also putting up a building. A feature of the Westinghouse exhibit will be a model power transmission plant, using an alternating current of high potential, and complete with generator, step-up and step-down transformers, line construction and motor. This company is also contemplating the establishment of a lamp renewal factory in its space. If this scheme is put in operation, all of the new Westinghouse lamps that burn out while in use in the World's Fair installation will be cleaned, fitted with fresh burners and made as good as new in full view of the

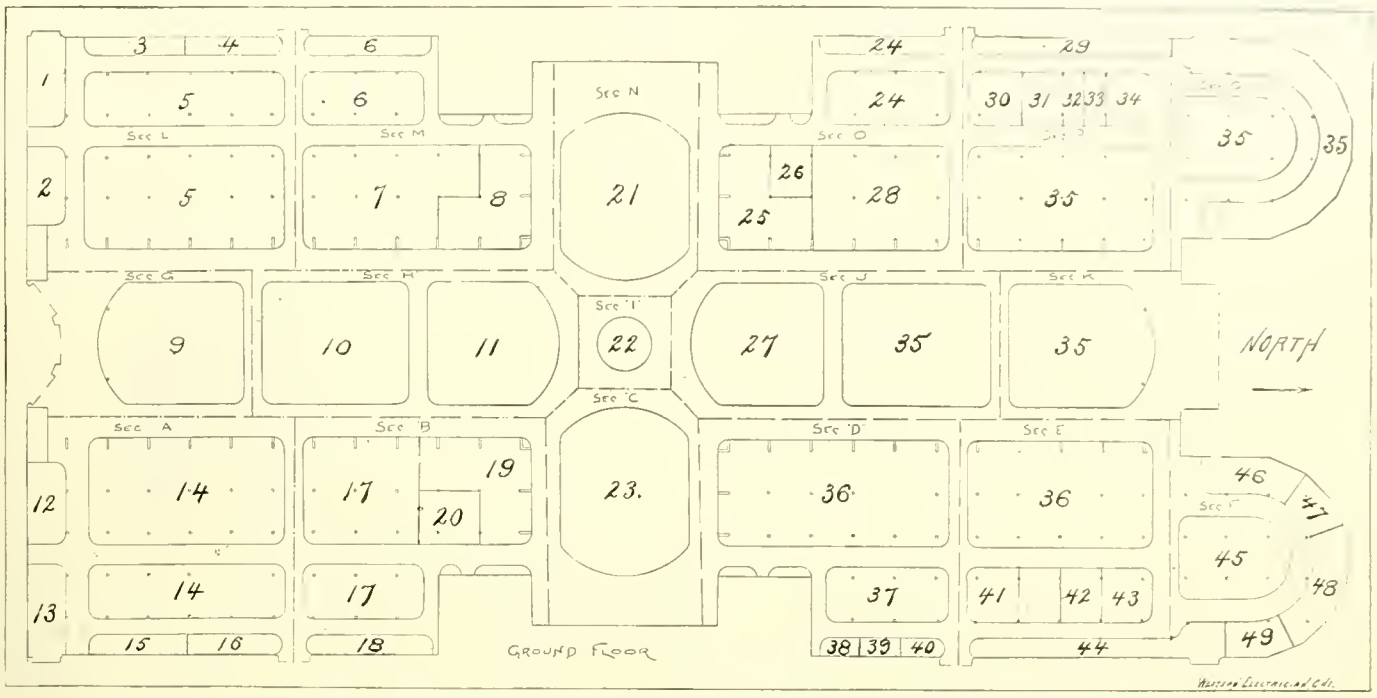

FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.—GROUND FLOOR OF ELECTRICAL BUILDING, SHOWING EXHIBITION SPACES.

1. Crocker-Wheeler Electric Co.
2. Jenney Electric Motor Co.
3. Hanson Van Winkle & Co.
4. Germania Electric Co.
5. Brush Electric Co., Short Electric Railway Co. and Swan Lamp Co.
6. National Electric Manufacturing Co.
7. Fort Wayne Electric Co.
8, 11, 19, 21, 23, 25, 27. General Electric Co.
9. American Bell Telephone Co.
10. Detroit Electrical Works.
12. C. & C. Electric Motor Co.
13. Sperry Electric Mining Machine Co.
14, 14. Western Electric Co.
15. La Roche Electric Works.
16. Hornell Iron Works.
17, 17. Westinghouse Electric & Manufacturing Co.
18. Eddy Electric Manufacturing Co.
20. Excelsior Electric Co.
22. Phœnix Glass Co.
24, 24. Thomson Electric Welding Co.
26. Heisler Electric Co.
28. England.
29. Italy.
30. Mexico.
31. Spain.
32. Russia.
33. ——
34. Belgium.
35, 35, 35, 35, 35. France.
36, 36. Germany.
37. Electric Forging Co.
38. Chas. A. Schieren & Co.
39. Munson Belting Co.
40. Page Belting Co.
41. Belknap Motor Co.
42. Arnold Electric Co.
43. A. C. Mather.
44. The E. S. Greeley & Co.
45. New York Insulated Wire Co.
46. Zucker & Leavitt Chemical Co.
47. Riker Electric Motor Co
48. Perkins Electric Lamp Co.
49. Akron Electrical Manufacturing Co.

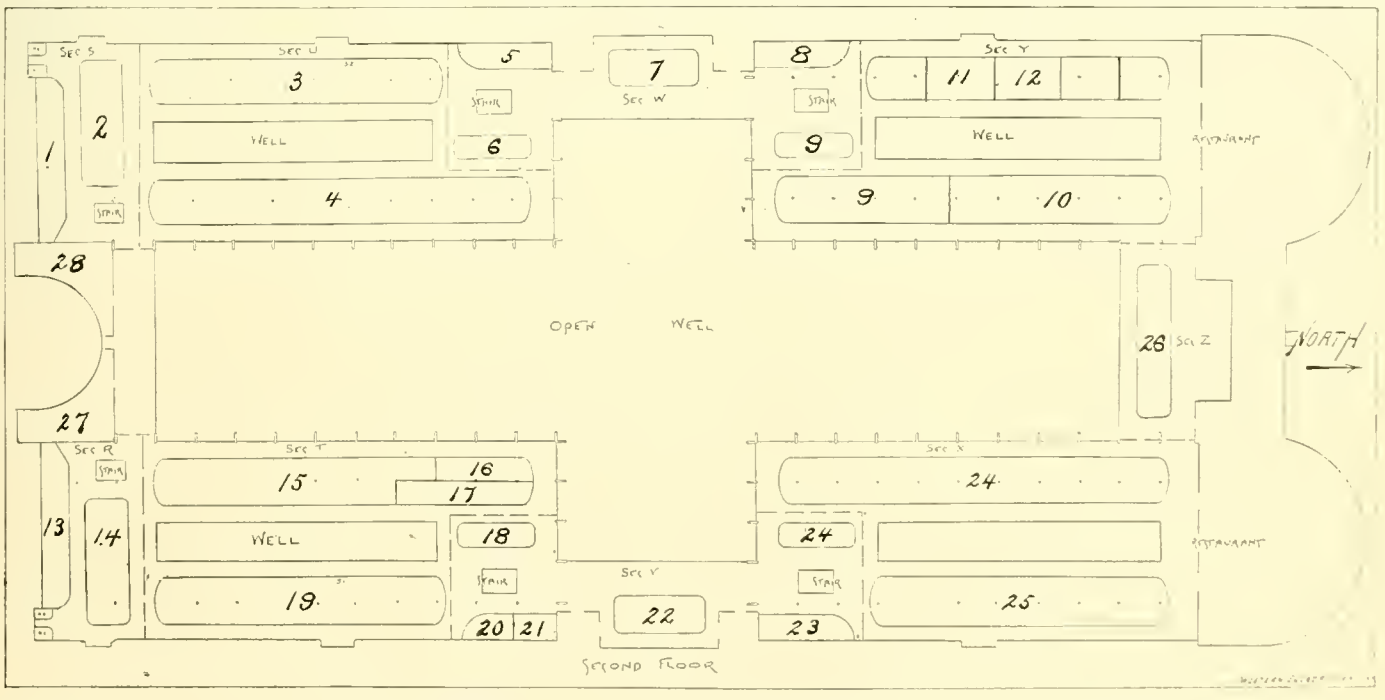

FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.—GALLERY FLOOR OF ELECTRICAL BUILDING, SHOWING EXHIBITION SPACES.

1. E. Berliner.
2, 3. Miscellaneous.
4. Electrical appliances.
5. Lafferty & Holmes.
6. McIntosh Battery & Optical Co.
7. Dayton Fan & Motor Co.
8. Elisha Gray.
9. England.
10. Canada.
11. Austria.
12. Italy.
13. Electrical specialties.
14. Weston Electrical Instrument Co.
15, 19. Wire exhibits.
16. Detroit Electrical Works.
17. Central Electric Co.
18. Gamewell Fire Alarm & Telegraph Co.
20. Washburn & Moen Manufacturing Co
21. American Storage Battery Co.
22. Queen & Co.
23. Western Union Telegraph Co.
24. Germany.
25. Testing Instruments.
26. Electrical Supply Co.
27. Department of Electricity, World's Columbian Exposition.
28. WESTERN ELECTRICIAN.

spectators in the building. This will make a novel exhibit. In the gallery will be shown the lighter exhibits, and several changes may yet be made in this portion of the building.

In Fig. 3 is shown a new arc lamp post, with incandescent decorative fixtures, designed for the bridges and for the railing south of the art gallery. The arc lights will be of 2,000 nominal candle power, while the incandescent lamps will be of 32 or 50 candle power, inclosed in lanterns of tinted or ground glass, and intended wholly for decorative effect. These posts were designed by the arc light section of the mechanical and electrical engineering bureau of the department of works, under the direction of George B. Foster. The erection of the ordi-

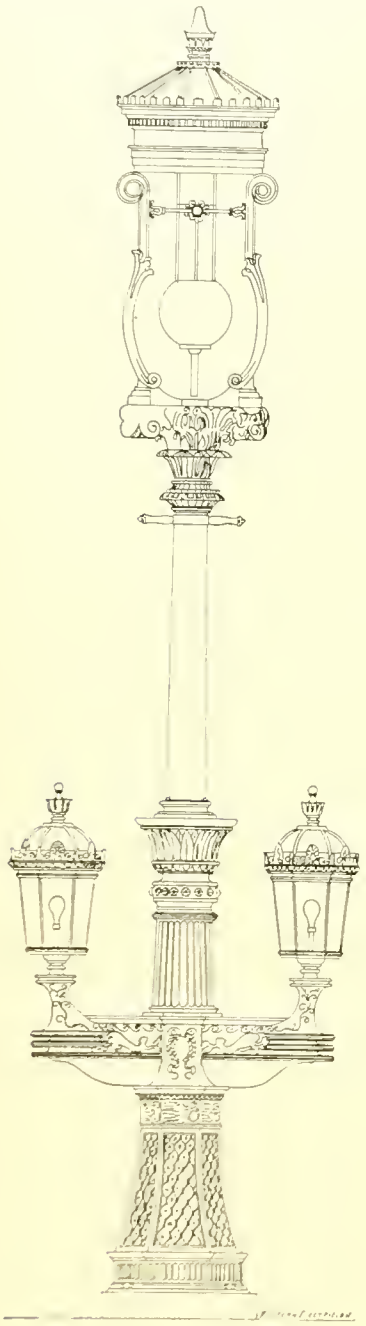

FIG. 3. ELECTRICITY AT THE WORLD'S FAIR.

nary arc lamp posts has been begun, and will shortly be carried on at the rate of 25 a day. The conductors will then be laid in the subways and ducts, and as fast as the permanent wiring is completed the temporary overhead construction will be taken down.

Two of the 10,000 light alternators were tested at the Westinghouse shops last week, and it is said that the results were very satisfactory, the efficiency ranging from 95 to 97 per cent. Five of the twelve big incandescent dynamos are now practically completed, and work is being pushed night and day on the others in the factory in Allegheny. The belt driven machines weigh 145,000 pounds each. A large number of people witnessed the test, including E. E. Keller, superintendent of the Westinghouse World's Fair installation, and Frederick Sargent, the World's Fair mechanical and electrical engineer. All told, the Westinghouse company will have about twenty dynamos at the World's Fair, with an ultimate capacity of 150,000 16 candle power lights.

The Royal Commission for the World's Fair is arranging for a series of introductions to the sections of the catalogue of the British section. That on "Electricity" will be by W. H. Preece, F.R.S.

The dispute over the boiler contract will be fought out in the courts. The Babcock & Wilcox company, representing the "Temporary association," is seeking an injunction to prevent the World's Fair people from installing Stirling boilers as a portion of the main steam plant of the exposition. The contention of this company is that the awarding of a minor contract to the Stirling company increases the risks borne under heavy bond by the complainant, for it is alleged that the Stirling boiler is of a type entirely different from that constructed by the six companies, and hence almost impossible to be operated in connection with the battery as a whole without increased risks. President Higinbotham of the World's Fair, in his answer, denies that any contract was made with the companies of the "Temporary association" to the exclusion of other companies. Mr. Higinbotham denies that the World's Fair ever assured the firm of Babcock & Wilcox that it should be allowed to furnish all additional power required for the main steam plant, or an exclusive right to put in boilers. It is admitted as a fact that the Babcock & Wilcox company was awarded a contract in May to put in ten boilers for certain rentals, but it is further alleged that the company has failed to meet the terms of the contract, which specified that the boilers were to be in place by September 1st and ready for continuous service after September 15th, and it is averred that the apparatus is not even now ready for service. The answer also states that the association boilers were accepted and assigned space simply as exhibits, and that it would contravene the spirit and letter of the act of Congress creating the exposition to allow one company to exhibit and to exclude another equally desirable exhibit. The Stirling company, declares

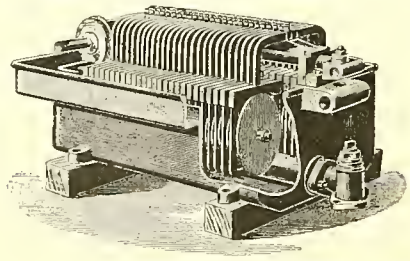

FIG 1. HERMITE ELECTROLYTIC BLEACHING PROCESS.

the answer, applied for space for an exhibit upon the same conditions as were imposed upon the Babcock & Wilcox company, and its application was allowed. The claim that the introduction of Stirling boilers will bring an element of danger into the concern is denied on the ground that the Stirling apparatus is not of perilous construction. Judge Ewing referred the matter to a master.

The rules in relation to electric light and power have been finally adopted. They differ somewhat from the rules of the commission published in the WESTERN ELECTRICIAN of December 17th. That portion in which changes have been made is herewith reproduced in accordance with the official text:

GENERAL CONDITIONS.

The director-general has general charge of the installation of all exhibits and the control and management of the same to the closing of the work of the exposition, through the department chiefs, under the system heretofore established and now recognized by law as existing agencies.

The director-general has exclusively to do with all exhibitors in their connection with or relation to the exposition, it being understood that so much of the regular power and light plant accepted as exhibits shall be under the control of the director of works.

Exhibitors desiring to contract for service of electricity, steam, compressed air, power from shafting, gas, or water, must make application to the chief of the department in which their exhibits are installed. No application will be entertained unless made upon a blank furnished by the chief of department, and when an application has been approved by the director-general a contract will be executed on the part of the World's Columbian Exposition by the director of works, provided it is not impracticable, on the terms and conditions hereinafter specified.

In no case will service be furnished except under authority of contract in writing, the payments for which shall be made by the applicant to the World's Columbian Exposition at the time of the execution of said contract.

Service will be provided from May 1, to October 30, 1893, inclusive.

The exposition management will not be responsible for stoppages from any reasonable cause.

A limited amount of power will be supplied gratuitously to turn over, periodically, an otherwise inoperative exhibit; the length of time such exhibit shall be operated, to be determined by the chief of department.

The authorized representative of the management of the World's Columbian Exposition shall have access to the consumer's space for the purpose of inspection at all reasonable hours.

ELECTRICITY FOR INCANDESCENT LIGHTING.

The generators, primary system of wiring and converters, will be installed, operated and maintained by the World's Columbian Exposition.

Service will be furnished from 100 volt alternating current system as manufactured by the Westinghouse Electric & Manufacturing company.

All lamps, sockets, switches, cut outs and other appliances must be adapted to the above named system.

All power service for generating light will be furnished during the exposition hours by the World's Columbian Exposition from the 1st of May to the 30th day of October, 1893, inclusive, at the rate of $8 per 16 candle power lamp capacity or the equivalent in lamps of other candle power.

National, state, territorial and foreign World's Fair boards and concessionares must install, operate and main-

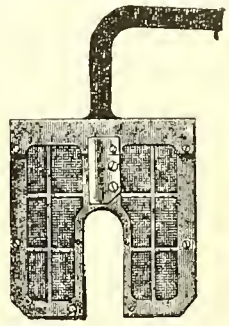

FIG. 2. HERMITE ELECTROLYTIC BLEACHING PROCESS.

tain the wiring system for lighting their respective buildings at their own expense. The installation shall comprise all conductors and appliances necessary, from the converter to the lamps, and the first installation of lamps. The plans for such installation must be submitted for the approval of the director of works before installation commences, and the work shall be installed so as to meet with the approval of the director of works before connections can be made with the main circuits. The actual work of connecting the converter with the secondary system will in all cases be done without extra expense by the World's Columbian Exposition.

Exhibitors occupying space in buildings owned by the World's Columbian Exposition must have their wiring installed by the World's Columbian Exposition through its authorized constructors. All wiring and appliances installed by the World's Columbian Exposition will be and remain the property of the World's Columbian Exposition. The class of wiring installed will be that known as plain moulding or interior conduit work, and will include the first installation of lamps, plain key or keyless sockets, switches, cut-outs, and the hanging of the lamps on plain cords or pendants, and shall be charged for at the rate of $3.50 per lamp. Special or fancy wiring will be furnished at an additional charge, covering the actual cost to the World's Columbian Exposition. All fixtures and shades must be furnished by the consumer. Changes in location of lamps and appliances, when once installed, shall be subject to an additional charge.

The lamps referred to herein, unless otherwise stipulated, are 16 candle power, plain lamps. Lamps of other capacities, and fancy lamps, will be subject to special agreement. Lamps of standard capacities for renewal purposes will be furnished to replace burned-out lamps

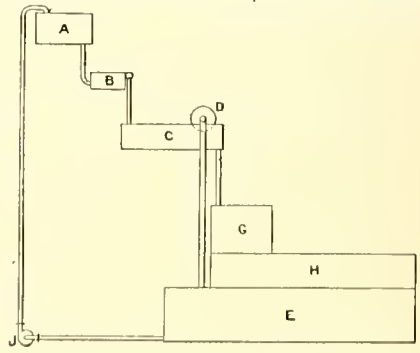

FIG. 3. HERMITE ELECTROLYTIC BLEACHING PROCESS.

free of cost to consumer. Lamps accidentally broken or lost will be replaced at the expense of the consumer, at the regular market rates. Special and fancy lamps must be renewed by the consumer.

ELECTRICITY FOR POWER SERVICE.

The generators and main conductors will be supplied, operated and maintained by the World's Columbian Exposition. The service conductors will be furnished at the consumer's expense, and at the rates hereinafter mentioned. The motors and appurtenances must be supplied, operated and maintained by and at the expense of the consumer. The service connections to the motors shall be installed, maintained and owned by the World's Columbian Exposition.

The motor shall be suitable to operate on a 500 volt constant potential circuit. The rheostat shall be constructed wholly of non-combustible material. The main line switch shall be of the "knife blade" type, and suitable for working on a 500 volt constant potential circuit.

No service will be rendered for less than $20. Fractions of horse power will not be considered, except fo

motors of less than one horse power. Charges will be made for service connections with the main line, at the following rates:

For ½ horse power and less..... $10
For 1 to 5 horse power..... 15 per horse power.
For more than 5 horse power, not exceeding 10 horse power..... 12 per horse power.
For more than 10 horse power..... 10 per horse power.

Charges for service will be based on the maximum electrical horse power delivered to the motor irrespective of the class of work to be operated by the motor, at the following rates:

For ¼ horse power, and less... ....$20
For more than ¼ horse power, not exceeding ½ horse power..... 40
For more ½ horse power, not exceeding 1 horse power..... 75
For more than 1 horse power, not exceeding 2 horse power..... 70 per horse power.
For more than 2 horse power, not exceeding 3 horse power..... 60 per horse power.
For more than 3 horse power ..... 60 per horse power.

Special service for motors not exceeding two horse power can be furnished from the regular alternating incandescent circuit.

The above rates contemplate continuous service, or service on demand at any time during the hours of the exposition, from May 1 to October 30, 1893, inclusive. Consumers requiring power service for a specified number of hours only, will be charged at the rate of five cents per electrical horse power hour; the specified time of day in which this service can be rendered, to be determined each day by the chief of the department.

ELECTRICITY FOR ARC LIGHTING.

The main aisles of the exposition buildings will be illuminated by arc lights free of expense to the exhibitor. A very limited number of arc lights will be supplied for private lighting on the following basis:

The consumer shall pay the cost of wiring.

The consumer shall pay for service from May 1 to October 30, 1893, inclusive, at the rate of $60 per lamp of two thousand (nominal) candle power.

Lamps will be suspended from the ceiling, and furnished with opal globes. If any special fixture is required, it shall be furnished by the consumer.

All care and maintenance of the lamps and circuits will be furnished by the World's Columbian Exposition without extra charge.

ELECTRICITY FOR CHARGING STORAGE BATTERIES.

The consumer shall provide lines and all material necessary from the main lines from which the current is to be distributed to storage batteries.

The consumer shall provide all necessary labor and attendance connected with charging or handling of the batteries.

Current will be provided at the rate of five cents per electrical horse power hour.

ELECTRICITY FOR MISCELLANEOUS PURPOSES.

Electricity for special purposes will be subject to special agreement to be determined at the time of making application therefor. Rates will be based either on those for power, or those for charging storage batteries, according to the class of work to be performed.

The rules governing the supply and use of light and power in the electricity building are substantially the same as those printed in this journal on December 17th, with the exception that "director of works" is generally substituted for "director-general." A typographical error also occurred in the former list, by which the cost of wiring for motors for from one to five horse power was given as $5 per horse power instead of $12 per horse power.

Hermite Electrolytic Bleaching Process.

At a recent meeting of the Society for the Encouragement of National Industry in Paris, a report relating to the Hermite bleaching process was presented. The report embodied the results of an investigation instituted by the committee on chemical arts, and was written by M. de Luynes. An abstract follows:

At the meeting of May 8, 1891, M. Hermite entertained the society by a description of his new processes for bleaching vegetable products by electro-chemical means. Your committee on chemical arts taking into consideration the importance of the work of Hermite, deputed two of its members, Aime Girard and the writer, to visit the manufactory of Montgolfier & Co., at Haye-Descartes, where the Hermite processes were to be seen in operation, in order to study the new methods by actual observation. As a result of this investigation I present this report.

The principal agents for bleaching vegetable fibers are the chlorides of lime or sodium, which are produced by the action of free chlorine on lime or sodium. To obtain these bleaching chlorides without resorting to the use of chlorine, chloride of sodium in an aqueous solution has been subjected to the action of the electric current. It was hoped that in this way a bleaching solution might be at once formed that could be substituted with advantage for the combinations ordinarily employed. These experiments, however, have not given practical results.

Hermite began his experiments in 1883. After studying carefully the actions that take place in the electrolysis of chloride of sodium, and recognizing that the use of this salt by itself must be abandoned, he was led to investigate the decomposition of the alkaline chlorides and alkaline earths. He fixed his choice upon chloride of magnesium, a salt which is abundant and cheap, and which possesses a number of advantages when used for this purpose. It is neutral, and the solution containing it presents only a small resistance to the passage of the electric current. The heat produced in combination is slight, and consequently its electro-chemical decomposition is easily effected. In a free state it has no deleterious effect upon vegetable fibers.

In seeking to determine the practical conditions in which chloride of magnesium could be used, Hermite proved at once that it could not be employed by itself; for by its decomposition there was formed hydrate of magnesia, which with undecomposed chloride of magnesium produced an oxychloride, which fouled the electrodes and thus impeded the passage of the electric current. To prevent this result he hit upon the combination of chloride of magnesium with another saline solution. The mixture which gave the best results was this: Water 1,000 parts; chloride of sodium 50 parts; chloride of magnesium, 5 parts. By electrolytic action in the bath only the chloride of magnesium appeared to be decomposed at the same time as the water. There was formed at the positive pole a product possessed of energetic decoloring power, and at the negative pole there was deposited gelatinous magnesia, which, in the presence of the small amount of chloride of magnesium, changed into an oxychloride. As the magnesia which is deposited at the negative pole does not remain in the solution long enough to combine with the oxygenated compound of chlorine at the positive pole, Hermite adds to the electrolytic fluid a certain quantity of hydrate of magnesia. There is nothing to be feared from the presence of free sodium arising from the decomposition of the chloride of sodium, for this base re-acts immediately upon the chloride of magnesium. The baths used by Hermite contain from five-tenths of a gramme to two grammes of chlorine in each litre.

According to the inventor, the liquid produced by electrolysis contains a hypochlorite of magnesia which is wholly neutral, and to this fact are attributed its remarkable qualities, as it bleaches fibers without altering them in any other way, and can be safely used on materials which one would not think of treating with the ordinary hypochlorites of commerce.

Hermite produces the decomposition of the salts and uses his bleaching compound in the following manner: The containing vessel is rectangular in shape, and is so cast that a ridge is formed on the inner side at the top. This serves as a sort of gutter, Fig. 1. Along the bottom runs a perforated pipe, through which the mixture of chloride of sodium and chloride of magnesium enters from a reservoir located at a higher level. The liquid fills the vessel and escapes through the channel or gutter into an overflow pipe. On each side of the perforated pipe are rods on which are mounted disks of zinc which constitute the negative electrodes. The positive electrodes are formed of sheets of platinum held in ebonite frames, Fig. 2. They are connected with strips of lead, which are attached to a bar of copper extending the length of the vessel. That the zinc disks forming the negative electrodes may be kept clean they are made to revolve and their surface is scraped by a knife edge. The apparatus is arranged in such a way that the positive plates can be taken out for inspection and repairs without interrupting the progress of the operation. When a number of electrolytic baths are employed they are connected in series. At Haye-Descartes a current of 1,200 amperes at 5 volts is employed. A general idea of the Hermite apparatus in use is given by Fig. 3. The mixture of chloride of magnesium and chloride of sodium runs from the reservoir *A* into the electrolytic bath *B*, thence to the bleaching vat *C*, which has a washing drum *D*, thence to a lower reservoir *E*, from which it is pumped back to *A*. The paper in the bleaching vat passes into a receptacle *G* or to a press *H*. The liquid which is squeezed out flows into the reservoir *E*.

The economy of the process will vary with different localities, and will depend to a great extent upon the cost of motive power. Here are some of the figures furnished by the inventor: An electrolytic bath of the Hermite system produces in 24 hours what is equivalent to 10 kilos of dry chloride of lime, and absorbs 10 horse power. The cost of the 10 horse power each day, if obtained from water, is estimated at 5.22 francs, or for steam 10.20 francs. The saving, then, would be from 80 per cent. with water power to 40 per cent. with steam. These figures are based upon the results of two years actual operation.

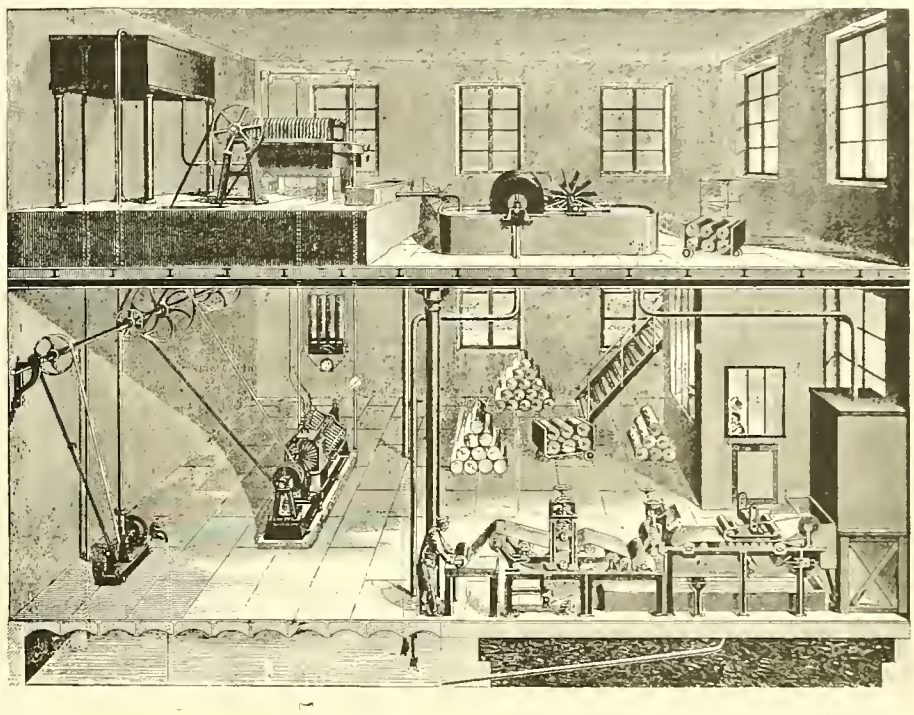

FIG. 4. HERMITE ELECTROLYTIC BLEACHING PROCESS.

Such have been the results ascertained by your committee. Power is furnished at Haye-Descartes by turbines. The batteries are composed of two groups of five baths each, which produce annually what is equivalent to 500,000 kilos of chloride of lime.

Fig. 4, which is reproduced from *L'Industrie Electrique*, represents an installation of the Hermite system for bleaching paper. On the upper floor is shown a reservoir, supported on columns, which feeds an electrolytic bath. The solution from the latter runs into a cement vessel and thence into a bleaching vat in which a proper amount of pulp has been placed. After the pulp is bleached it is carried to the reservoir shown at the right in the lower floor, while the solution flows to the reservoir under the floor at the left. The solution squeezed out in the press is piped into the same collector, whence it is pumped to the reservoir on the floor above, as the illustration indicates. On the lower floor also is located the dynamo from which current is derived for the electrolytic process.

Those who attended the Montreal convention will be interested in the statement that Mayor McShane of Montreal has refused to sign a contract with the Royal Electric company for the city lighting without calling for tenders, stating that he would rather go to jail.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE diagrams presented on another page showing the allotment of space in the electricity building at the World's Fair will possess much interest to all the members of the electrical fraternity. They indicate that all the prominent American houses, with two or three exceptions, will make exhibits. The display promises to be very useful as well as exceedingly attractive, and reflects credit on those making the arrangement.

AT THE time of the outbreak of cholera at Rouen and Havre, in France, electrolytic methods of disinfection were employed, as described in last weeks' issue of this paper. The subject is one of peculiar interest to Americans at this time, and the progress that has been made in perfecting the system is encouraging to investigators. Already excellent results have been secured at Rouen, and it is to be hoped that the problem will receive the attention in this country its importance demands. In all large cities there is special reason for the application of some method for destroying infectious germs. In Paris, for instance, sewage from the city mains is employed in irrigation in the plains on the left bank of the Seine. There are several hundred acres of land at present under treatment, and unless the sewage is made innocuous by some method of disinfection, it can readily be seen these fields will become a menace to the health of the surrounding country as the infectious germs are developed there, unless the sewage is sterilized. It is claimed that wherever sea water is procurable, the problem of electrolytic disinfection becomes simple and practicable. This is timely warning and should be heeded by the sanitary commissioners of ports.

DURING the last few weeks the storms that have raged throughout the country have greatly impeded street railway traffic. Even the "L" roads of New York experienced great difficulty in operating their trains, and no pretense was made of running upon schedule time. Yet, while the surface roads were blockaded and the elevated service crippled, the trolley lines were operated without interruption, and even the New York dailies, which have been fighting the overhead system, were compelled to admit that the electric railways had provided superior accommodations, and that they alone had successfully combated the storm. This is a notable victory for the trolley, and, while the friends of that system expected no other result, they are nevertheless elated over this demonstration of the superiority of the overhead electric railway.

NOW that the reports of both the English and American committees on the World's Electrical Congress have been submitted, electricians at home and abroad have a wide field of discussion opened before them. The suggestion of the American committee that the proposed reforms and innovations be generally discussed through the columns of the technical press before the opening of the congress is a good one, and we hope that all interested in the subject will avail themselves of this invitation. The action of the congress can only be effective by enlisting the hearty co-operation of the entire electrical fraternity, and this can best be secured by arousing general interest prior to the assembling of the delegates. Let each contribute his mite, and the mass of opinion thus obtained will form an authoritative basis of action for the congress. By availing itself of this material and by not attempting too much, the electrical congress may leave behind it a record of lasting results.

REFERRING to the articles on "Electricity in Japan," written for this journal by Kuichiko Iwadare, an English contemporary sounds a note of alarm in commenting upon the fact that the electrical machinery used in Japan is almost exclusively of American manufacture. "This is, we think, a pity," it says; "there is, without doubt, a large field open in Japan for electrical works, as the projects already resolved upon, and partly carried out, testify. From present appearances, it would seem that the greater portion of the plant required will be of American manufacture, and the methods followed will be those worked out in the same country. We think there is no doubt that eventually the 'English of the East' will construct all the electrical machinery they require, but until that time comes, there is a good market for electrical wares in Japan; and we trust that our English manufacturers will bear this in mind, and endeavor to obtain a larger portion of the orders from that progressive and interesting country than they have hitherto been successful in securing." This advice is undoubtedly sound from an English point of view; but it may also serve to point out to the American electrical fraternity the ever-present danger of British competition in this market. The present preponderance can only be maintained by constant watchfulness.

ALTHOUGH the projectors of the Chicago South Side Rapid Transit system adopted steam instead of electric locomotives, it looks as though electric motors would have to be adopted if it desires to take advantage of the proposed down-town loop now under consideration. It is proposed to organize a corporation to be known as the Central Elevated Railroad company, for the purpose of building an elevated terminal loop for the use of all the "L" roads now existing or projected. The company has already secured an agreement with the Lake street elevated road, and the Metropolitan company has made a verbal agreement to use the new terminal tracks. Efforts are also being made to get the South Side alley road far enough north to make the new loop available for its use, and the present prospects of success are most encouraging. One of the projectors of this enterprise pays the following tribute to the superiority of the electric motor over the steam locomotive: "The trains that go over our loop will be taken over by our own electric motors. Each train will surrender its engine when it reaches us, for we would all have to vacate for the puffing racket, and the smoke in the alleys would drive us all out and make business impossible. Electric motors will enable us to escape the noise and smoke. The trains of the several roads can be hitched to their own engines again at the point of connection between the roads and the loop. We will be able to handle twenty-four trains at a time on the loop."

BY applying for injunctions against the Sunbeam, Columbia and Illinois Incandescent Lamp companies, the General Electric company has now indicated the policy it will follow in dealing with rival lamp companies. There is no question but that the General Electric company will endeavor to establish its exclusive right to manufacture incandescent lamps, and to do this of course it will bring proceedings against every lamp company in the country. The Sunbeam, Columbia and Illinois companies, it is expected, will endeavor to secure a trial, as they have never been in litigation with the Edison interests. Should the General Electric company, however, secure permanent injunctions against these concerns, its future course concerning them will be watched with interest. It is not improbable that arrangements may yet be made which will enable these companies to continue making lamps under licenses granted by the General Electric company. It is thought that the latter company considers that it could make much more favorable terms with rival lamp companies after closing their factories. The most important question which confronts the electrical interests, and the one in which the public generally is most concerned, is the supply of lamps. Should the General Electric company succeed in closing the factories of rival companies, the dynamo output would be necessarily limited, and lamps sufficient for plants already in existence could not be furnished from the Edison factories. It is hardly possible that such a policy will be pursued. The impression still prevails that arrangements will be made by which the larger factories will continue to make lamps under licenses from the General Electric company.

WITH that pert flippancy which has become a characteristic, the *Chicago Evening Post*, in the course of a recent editorial on "Rival Electric Street Car Motors," makes this statement: "The overhead wires are not only unsightly; they are an obstruction to the streets, and are a standing menace to the safety of the community. Lives have been sacrificed by them in cities where they have long been in use. Any break in them or in the current they convey causes an instant cessation of travel on the road, resulting in a blockade of general traffic on the street. The system is at best uncertain, and its working has proved unsatisfactory wherever it has been tried. It is influenced by the state of the weather and subject to interruptions from a hundred and one other causes."

So much of this is entirely untrue that it is difficult to reply to it with patience and moderation. In the whole arraignment there is only one valid objection to the overhead trolley system—the esthetic one that the poles and wires are unsightly. All the other charges are simply balderdash. For instance, how are the wires a "standing menace to the safety of the community"? Can the *Post* point to one authenticated instance in which human life has been "sacrificed" by them "in cities where they have been long in use"? Boston, St. Louis, Minneapolis, Cleveland and Buffalo are such cities. Let the *Post* look up the records. Philadelphia is a city in which a great outcry was made against the introduction of the trolley system. But now, after a trial, the people are greatly pleased, if the *Record* of that city is considered good authority. It is also untrue to say that a break in the trolley wire would cause "an instant cessation of travel on the road, resulting in a blockade of general traffic on the street." Such an accident would merely interfere with that section of the line embraced between the two nearest feeder wires and could be more speedily remedied than a cable break-down, for instance. The statement that "the system is at best uncertain, and its working has proved unsatisfactory wherever it has been tried," is as complete a perversion of the facts as could be made. Wherever introduced the overhead electric railway has been retained and extended, receiving the general approval of the public. The growth of the system within the last ten years has been simply marvelous, until now it is in operation in nearly all the cities and principal towns of the country, except New York and Chicago. This fact is a complete refutation of the accusation that the overhead system has proved unsatisfactory.

The strictures of the *Post* were made in the course of a comparison of the overhead trolley and storage battery systems. The latter can gain nothing, however, by a willful misrepresentation of the standard method of electric traction.

World's Electrical Congress.

The sub committee of the International Electrical Congress committee of the American Institute of Electrical Engineers has made its report, containing recommendations for the conduct of the World's Electrical Congress and a list of subjects to be discussed. This report, together with that of the representatives of the English electricians, is now under consideration by the Advisory council of the World's Congress Auxiliary. The recommendations of English committee were published in the last issue of the WESTERN ELECTRICIAN. Following is the substance of the American committee's report:

RATIFICATIONS.

1. *Ratification of the adoption of units, terms, symbols and definitions by previous international electrical congresses.*

This is a mere matter of form and an act of courtesy to the preceding congresses. Your committee understands that this was done at both the Paris congress of 1889 and the Frankfort congress of 1891.

NEW UNITS.

2. *Defining and adopting practical units for measuring and designating the measurements of the following quantities: Magneto-motive force, magnetic flux, magnetic intensity; magnetic reluctance, electric conductivity, illumination.*

It will be noticed that this refers only to the question of what the magnitude of the units shall be, or, in other words, what multiples or sub-multiples of the absolute units they are to be.

Your committee is aware that objections are raised by some to the establishment of units not already in universal use. Past experience, however, has shown that the proper time to establish units is before their need is universally felt, in order to avoid the introduction by different persons or nations of units of different values, a contingency which will be very likely to arise if not anticipated by concerted action.

Your committee recommends the following:

The value of the practical unit of magneto-motive force to be one-tenth of the absolute unit; that is, equal to

$$\frac{1}{4\pi}$$

ampere turo.

The value of the practical unit of magnetic flux to be 10^8 absolute units or lines.

The value of the practical unit of magnetic intensity to be 10^8 absolute units, that is, 10^8 lines per square centimetre.

The value of the practical unit of reluctance to be 10^9 absolute units.

The value of the practical unit of electrical conductivity to be 10^{-9} absolute units, that is, to the reciprocal of the ohm. This makes it equal to the unit proposed some time ago, and known to some extent by the name of "mho." It should be given this value in order that it correspond with the already adopted units.

The value of the practical unit of illumination to be a bougie-decimale at the distance of one meter. The bougie-decimale is the unit of light or candle power already established, and is practically equal to one English standard candle; by making the distance a meter, the practical unit will be approximately equal to one-tenth of a carcel-metre, one-tenth of a foot candle (or "lux") or to one meter candle or meter kerze, all three of which units are already in use to some extent.

It has been announced that a proposition will be made at this congress to change the values of some of the practical units which have been adopted by previous congresses, and are already in universal use. Among these are the ampere and the farad. It is urgently recommended by your committee that such changes should not be favored, since they would necessarily be followed by great confusion, and would of necessity have to be accompanied by some change in these well established names in order to distinguish these new units from those now existing.

NAMES FOR UNITS.

3. *Adopting names for the following practical units: Magneto motive force, magnetic flux, magnetic intensity, magnetic reluctance, inductance, electrical conductivity, illumination.*

The following names are suggested for these units:

For the practical unit of magneto-motive force, the name "gilbert."

For the practical unit for magnetic flux, the name "weber." This term was formerly applied to a unit of current, but its use in this sense was so limited, and it has been abandoned for so long a time, that no confusion would be likely to arise; the context alone would always be sufficient to prevent any possibility of misunderstanding. The name "weber" is preferred on account of the intimate relation between this unit and that of magnetic intensity, for which the name "gauss" is suggested.

For the practical unit of magnetic intensity, the name "gauss." This name has already come into use to such an extent that objections to it will not be likely to arise.

For the practical unit of magnetic reluctance, the name "oersted."

For the practical unit of inductance, the name "henry." This name has already come into use quite extensively, and it would therefore be very undesirable to change it. The value of this unit has already been fixed as equal to 10^9 absolute units or nearly to the length of an earth's quadrant. The definition "quadrant" is sometimes employed as the name itself, but its use as a name is evidently objectionable, as it already has several other meanings, which might readily lead to confusion.

For the practical unit of electrical conductivity, equal to the reciprocal of the ohm, the name "mho." This name has been in use for some time, and is already well known. It is thought better to recommend it than to select and introduce a new name.

For the practical unit of illumination defined above, the name "bougie meter."

It has been suggested to name the units "kilowatt hour" and "ampere-hour." Your committee, however, recommends that inasmuch as these terms explain themselves, and are not longer than some others in use, to give them special names would burden a system of nomenclature unnecessarily. The principal objections to the term "board of trade unit," which is in use in England for the former, are, that it could never become international, that it is longer by one syllable than the term "kilowatt-hour," and that there are now, or may soon be, units of other denominations adopted by the same board of trade, from which this one will have to be distinguished by an additional affix or prefix.

CONCRETE STANDARDS.

4. *Defining and adopting modes of embodying the following principal units of measurement in concrete standards capable of being readily reproduced, and adopting names for them or for the theoretical units, by which they can be distinguished from each other: Ampere, ohm, volt, watt, standard candle.*

The following definitions of these units are recommended:

An ampere shall be that unvarying current, which, when passed through a solution of nitrate of silver and water, in accordance with the specifications recommended in the recent report to the British Board of Trade, deposits silver at the rate of 0.001118 of a gramme per second.

An ohm shall be the resistance offered by a column of mercury at the temperature of melting ice 14.4521 grammes in mass, of a constant cross-sectional area, and of a length of 106.3 centimeters. It is recommended that material standards of this value, constructed in solid metal, should be preserved under the care of the several governments, as standards of comparison, and that they should from time to time be verified by comparison with the mercury standard defined above; also that for the purpose of replacing the standard, if lost, destroyed, or damaged, and for ordinary use, a limited number of copies should be constructed which should be periodically compared with the standard ohm.

A volt shall be the product of this ampere and this ohm.

A watt shall be the product of the square of this ampere and this ohm.

The other units, such as the coulomb, the farad and the joule shall be taken as derivatives in terms of this ampere and this ohm.

In order to create as little confusion as possible by the introduction of this set of units, which are to become the universal standards, and in order to distinguish them readily from the true theoretical or abstract units defined in terms of the absolute units, it is recommended to call the former simply "amperes," "ohms," "volts," etc., or more specifically "standard amperes," "standard ohms," etc., and to call the theoretical units "true amperes," "true ohms," etc. The latter term has already come into use in this sense.

The unit of resistance known as the B. A. unit shall be taken as equal to 0.9866 of this ohm.

The electromotive force of a Clark cell at 15° C., prepared in accordance with the specification recommended in the recent report to the British Board of Trade, shall be taken as not different from 1.434 of these volts by more than one part in one thousand. The coefficient of temperature shall be taken as..... ?

The standard candle shall be taken as equal to the light from a lamp like that known as the Hefner-Alteneck standard amyl acetate lamp, which is to be defined by its dimensions and the height of the flame, the dimensions being such that the light shall be equal to that of the "bougie-decimale," the practical unit adopted at the Paris congress of 1889, which is equal to one-twentieth of the absolute platinum standard adopted in 1884.

It has also been suggested that a universal wire gauge be defined and adopted. Desirable as this may at first seem, your committee recommends that no action be taken by the congress in this matter, as it is not likely that any one scale would ever be universally adopted by manufacturers, even if defined and adopted by a congress. The universal introduction of the metric system and the designation of wires by their diameters in millimetres is thought to be the only satisfactory solution of this question for international work.

NOTATION AND SYMBOLS.

5. *Adopting an international system of notation and conventional symbols, for designating different quantities.*

The system suggested to the last congress by E. Hospitalier of Paris, is recommended by your committee, although doubtless some amendments may be found desirable.

DEFINITIONS.

6. *Defining the following terms: Impressed electromotive force, inductivity, inductance, reluctivity, Matthiessen's standard, north and south pole.*

The following definitions are suggested:

The impressed electromotive force is the ratio of the total activity in an electrically conducting circuit to its instantaneous current strength.

The inductivity at any point in an isotropic medium is the ratio, added to unity, of 4π times the intensity of magnetization there existing, to the magnetizing flux density. Inductivity is synonymous with "permeability." The electro-magnetic dimensional formula is $L\ M\ T^{-1}$; the conventional symbol is μ.

Inductance.—(*a*) Self-inductance is the ratio of the total magnetic induction linked with and established by an electric current, to the uniform strength of the same. The inductance of a conducting circuit is constant when its environing medium has constant inductivity. (*b*) Mutual inductance of one electric circuit upon another is the ratio of the total magnetic induction linked with the second, due to a uniform current in the first, to the strength of that current. The mutual inductance for any two electric circuits is reciprocally equal when the environing medium has constant inductivity. The electromagnetic dimensional formula is $L\ M\ T^{-1}$. The absolute unit is one centimeter; the practical unit, one henry.

The reluctivity of a medium at any point is the reciprocal differential of the reluctance thereat. Simple definition: Reluctivity is the reluctance per unit volume. The electro magnetic dimensional formula is $L^{-1}\ M^{-1}\ T^2$. The absolute unit is one C. G. S. unit of reluctance per cubic centimeter; the proposed practical unit is the same or about one oersted per cubic earth quadrant.

The resistance of copper known as Matthiessen's standard shall be defined as follows: The resistance of a soft copper wire one meter long, weighing one gramme, is 0.14365 B. A. units at 0 °. This definition is recommended by the committee of the American Institute of Electrical Engineers on Matthiessen's standard. The reasons for selecting it are given in that report.

The north pole of a magnet to be defined as being that which seeks the geographic north pole, and the south pole that which seeks the geographic south pole. This is the generally accepted definition, but it is thought desirable to formally define it.

EXPRESSIONS.

Defining and adopting expressions: For alternating currents of more than one phase; for describing phenomena of alternating currents and of electro magnetic waves.

It is recommended to adopt the following expressions: "Simple" alternating current for the usual alternating currents in which there is practically but a single phase; "diphase" alternating currents for two alternating currents whose phases differ in time by 90 or 270 deg.; "tri phase" alternating currents for three alternating currents whose phases differ in time by 60 or 120 deg.; "polyphase" alternating currents for such as have more than three phases.

For expressions describing phenomena of alternating currents and electro-magnetic waves, your committee solicits suggestions.

UNIVERSAL USE.

8. *Recommending the more universal use—*

Of the term "voltage" as synonymous with "difference of electrical potential" or P. D. in place of the terms "potential," "tension," or "pressure," the use of which in this sense it is recommended to abandon;

Of the term "transformer" instead of "converter;"

Of the term "dynamotor" for a continuous current transformer;

Of the term "continuous current" instead of "direct current;"

Of the term "kilowatt" instead of "horse power;"

Of the metric system of weights and measures, and suggesting means by which its introduction will be facilitated.

PROGRAMME.

Regarding the programme for carrying out this work in the most satisfactory manner to all parties, and with the least loss of time, your committee's recommendations and suggestions are as follows:

It cannot be too strongly urged that an international congress is the place to close, but not to open a discussion on questions about which international agreement is to be had; it is therefore urgently recommended that action be taken at once, to open the discussion of such matters now, in order that expressions of opinion, and, if possible, agreements, may be arrived at prior to the meeting of the congress. To this end your committee recommends that the suggestions embodied in this report, or as many of them as you may see fit to designate, be printed and sent to all the leading electrical and physical societies and journals in this country and abroad, with a request that they aid this work by making them public, by freely discussing them, and by sending copies of such discussions and any further suggestions to the general congress committee of this institute, care of secretary, 12 West Thirty-first street, New York city. That a sub-committee of the institute prepare from time to time a classified summary of such discussions to be sent to the leading electrical and physical journals for publication here and abroad, and that it present a final summary of this international discussion at the congress. This discussion ought to be closed by July 1, 1893.

It is recommended also that this institute invite other societies to co-operate with it by appointing special committees to discuss and report to their respective societies on these international questions, and to publish their conclusions in the electrical journals of their country.

It has been suggested that various committees be appointed to prepare reports on the international questions on which agreement is desired, and to submit these at the meeting of the congress. Your committee, however, believes that to postpone the discussion until the congress is in session, would lead to no satisfactory results, as was shown at the last congress of 1891, in Frankfort. It therefore urges that the discussion take place through the medium of the journals prior to the meeting of the congress, and that the only report submitted to the congress be a summary of such discussions.

Regarding the meetings of the congress, your committee recommends that, as in the Paris congress of 1889, the meetings be divided into (a) *General Meetings*, one at the opening and one at the closing of the congress, which are to be devoted to the consideration of general questions and those on which agreements are desired, and to the reading of papers of a general character; (b) *Sectional Meet-*

ings for the reading of all other papers. The following division into sections is recommended:

1. Electro-physics, units, measurements, and all electrical matters of a purely scientific nature.
2. Dynamos, motors, transformers, etc.
3. Systems, central stations, installations, lamps, etc.
4. Electric telegraphy, telephony, and signaling.
5. Electric railways.
6. Electro-chemi try, batteries, electro-metallurgy.
7. Electro-physiology and electro-therapeutics.
8. Legal questions.

It is suggested that specific invitations be extended by the congress auxiliary to prominent electrical engineers and physicists to prepare papers on specified subjects to be read and discussed at the congress meetings. Also, that a general invitation be extended for other papers, which are to be submitted not later than July 15, 1893, to a committee on papers appointed by the chairman of the congress auxiliary; that this committee shall examine and accept or return the latter, and at its discretion shall print any or all of those accepted as well as those solicited, in form for circulation at least one week prior to the meeting at which they are to be read; that the papers shall be read in full, in abstract or by title, as that committee shall direct.

The following subjects of papers are offered as a suggestion to the congress auxiliary merely as a basis and not as a complete list:

The criterion of sensitiveness of galvanometers; or on the theory of their construction.
The working of national or municipal laboratories for testing meters and instruments.
The practical results and economy of the employment of accumulators in central station systems of supply.
On the relationbetween weight of copper and iron in dynamos and their output.
Nomenclature and notation of magnetic circuit—or on standard and units of magnetism.
Magnetism.
On the economic use of transformers under various conditions of supply.
Electricity meters from a European standpoint.
Electricity meters from a British standpoint.
Electricity meters from an American standpoint.
Choice of materials for standard of electrical resistance.
Nomenclature of phenomena of electro-magnetic waves.
Standards for electrical measurement.
Alternating current transformers from an American standpoint.
High frequency and high potential phenomena.
Dynamo construction.

Your committee suggests that papers should be solicited by the general congress committee of this institute on the work of the early electricians of this and foreign countries considered from a modern standpoint, and their importance in the development of the science of electricity, including descriptions and illustrations of models and apparatus used.

Your committee suggests that the proper authorities be requested to have a stenographic report made of the proceedings and discussions at all the meetings of the World's Electrical congress, and that this report, including such of the papers and discussions as a committee appointed for the purpose shall direct, shall be printed and published in book form; that each member of the congress be entitled to one copy of this report on the payment of $1, and non-members on the payment of $5.

It is suggested that the membership of the congress be divided into delegated members and members; that the dues for each shall be $5; that only delegated members and members be admitted to the meetings, and be permitted to take part in the discussions; that any one shall be entitled to become a member: that delegated members shall be appointed by governments, physical and electrical societies, and shall be approved by an international committee whose decision shall be final; that questions on which international agreement is desired be decided by the delegated members, whose decisions shall be submitted to the whole

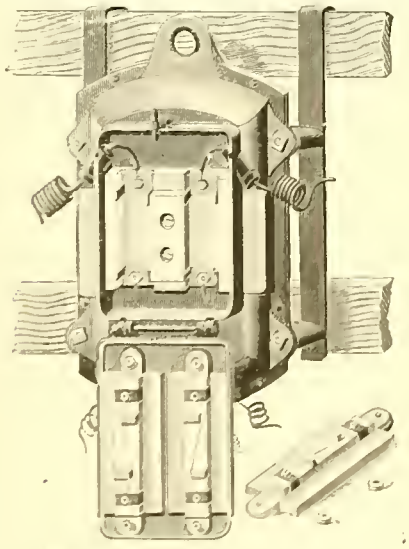


FIG. 2. THE DIAMOND TRANSFORMER.

congress for approval or rejection in part or in whole, but not for alteration.

It is recommended that the United States government be requested to extend a formal invitation to foreign governments and societies to send delegates to this congress.

In the present report your committee has embodied recommendations from the reports of the Institute's Committee on Mathiessen's Standard, and on Magnetic Units, from the recent reports of the British Board of Trade Committee, and from the suggestions of Dr. Silvanus P. Thompson to Dr. Elisha Gray, in reference to the congress.

The Diamond Transformer.

It is only within a comparatively short time that transformers have been manufactured apart from generating apparatus, or since both articles were made by the same companies. Practical experience, however, suggested so many economies that might be effected by improved types of transformers that about two years ago factories outside

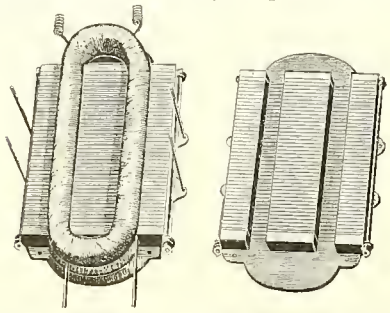


FIG. 3. THE DIAMOND TRANSFORMER.

of parent companies were established for the exclusive manufacture of transformers and kindred articles.

The Diamond transformer is the latest type which has been placed upon the market, and embodies all that experience has obtained from the good qualities of other converters. A transformer to be popular in these days with the superintendent of central stations and with linemen must be convenient and easily attached to poles or buildings.

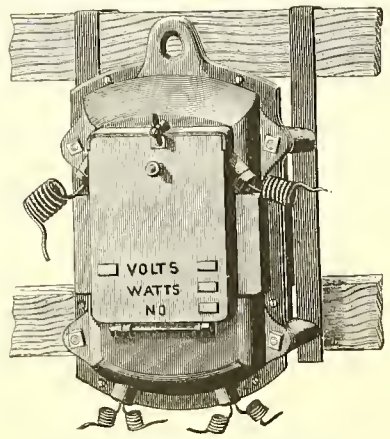
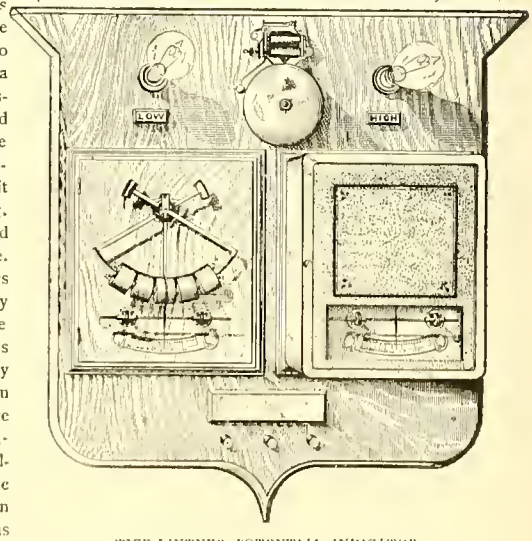


FIG. 1. THE DIAMOND TRANSFORMER.

Fig. 1 illustrates this transformer as it appears when attached to the cross arm. It will be seen that this converter is easily adjusted and held in secure position by the hooks engaging with the cross arms. The ring in the top is for hoisting upon a pole by means of a block and tackle. Should, however, it be necessary to attach this converter to brick walls, the hooks may be easily removed and the converter secured to the wall by means of the four lugs shown in the cut. The Diamond transformer is also made three-point, and is easily and quickly convertible from 50 to 100 volts on the secondary wires without the use of a clumsy and inconvenient switch. Fig. 2 shows the transformer with fuse box exposed to view. The primary and secondary connections are readily seen, and it will also be noticed that when the door is closed each fuse is in a separate compartment, so that in case one should blow out, it would have no effect upon the other by excessive heating. The porcelain box and fuse blocks are highly glazed, and it is claimed that there is no danger of absorbing moisture. The fuse blocks are attached to the door itself. It follows that when the door is opened the connection is completely broken, and a lineman may replace fuses upon a live wire with perfect safety, at the same time having the fuse blocks entirely exposed to view. The fuse blocks themselves may be detached by means of a little knurled thumb-piece, shown at the side of the detached block. These fuse blocks are interchangeable for all sizes of transformers, so that a central station, by keeping a few of them on hand, may always be assured of a fuse block in case one upon the line should be broken by lightning or otherwise. It has been a source of inconvenience and expense to central stations heretofore to return burned out converters to the respective factories to be repaired or replaced. The delay has often caused serious inconvenience, and it has resulted in many cases in the larger stations making ineffectual attempts to repair the converters themselves. Fig. 3 illustrates one of the most important claims of the Diamond converter to the appreciation of practical central station men. It will be seen that the secondary coils are in two parts, the primary coil being securely imbedded between the two, thus affording a common center of magnetism. After the primary coil is in position the secondary coils are adjusted and firmly bolted together, completing a perfect magnetic circuit. Should, however, a primary coil be burned out by lightning or otherwise, it is only necessary to have another coil sent by express, when the central station man can readily place it in position himself, thus obviating all the delay and expense which are a necessary part of the old method. The Diamond converter is of high efficiency, excellent regulation and low leakage current. It is made as light in weight as is consistent with the best practice, and is well ventilated through the top and bottom of the case, so that a free passage of air will aid in keeping the coils at a low temperature. Taylor, Goodhue & Ames, 827 Monadnock building, Chicago, have taken the exclusive agency for the sale of this converter.

The Tice-Lintner Potential Indicator.

Recognizing the necessity of close potential regulation, and believing that with more perfect regulation lamp breakage would be reduced to a minimum, the Tice-Lintner Electric company of Minneapolis has perfected an instrument which combines with a volt-meter of the highest degree of accuracy, permanency and dead beat qualities, an alarm attachment of equal reliability, which immediately attracts the attention of the attendant to any change or variation in pressure. Red and green lamps, to indicate whether the pressure is high or low, are provided, and lighted simultaneously with the ringing of the alarm bell. The indicator is now in successful operation in several large lighting plants, and its introduction has been attended with a marked diminution in lamp breakage. In fact there can be no perceptible increase of potential without the dynamo attendant being immediately apprised of the fact where this device is employed. The instrument is wound in such a manner as to produce a field of the greatest intensity, with the lowest possible temperature co-efficient, and is not subject to change or deterioration. This intensity of field results in the indicator being little affected by the close proximity of circuits carrying heavy currents or by other similar agencies so troublesome to most measuring instruments. In its construction it has been the aim of the inventors to concentrate the action within the normal limit of the system on which it is placed, so as to give to the index arm the requisite degree of force essential to a circuit closing device. Two delicately balanced armatures of the soft iron, to one of which is attached the index, are acted upon by the magnetic field of a curved solenoid in such a manner as to form opposite poles at their contiguous extremities, the mutual attraction of which greatly augments the directive force of the solenoid. This attractive force of the iron cores increases very rapidly as they approach and diminishes as rapidly as they recede, thus giving to the instrument great delicacy of action and securing wide range of movement to the circuit closing index arm for the slightest change of potential. The alarm circuit, together with that of the signal lamps, is completed through one of the two platinum tipped contact points set on either side of the index, which are adjustable,

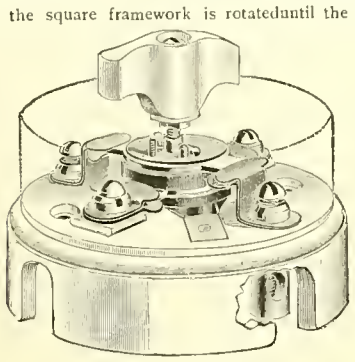


TICE-LINTNER POTENTIAL INDICATOR.

by turning a milled head to any desired range, from a fraction of a volt up. If desired the contact points may be removed to the extreme ends of the scale to permit of using the instrument as a volt meter. A general view of the instrument is shown in the accompanying illustrations, one of which represents the three-wire indicator with one of the ground glass covers removed. The indicator is manufactured in a variety of ranges for two and three-wire lighting systems, street railway and other power circuits.

New Double Pole Switch.

The accompanying cut illustrates a new double pole 25-ampere snap switch placed on the market by the Electrical Engineering Supply company of Syracuse, N. Y. The contact is made by rotating metal arms mounted on a spindle and insulated from each other. These arms are arranged to pass between two metal contact pieces mounted on each of the four binding posts so as to make a long wiping knife contact between the parts on both sides of the contact arms. In order to make and break instantly, there are arranged in a recess in the porcelain base two elliptic steel springs which press against the sides of a square framwork holding a roller in each of its corners, so that in turning the handle the square framework is rotateduntil the rollers



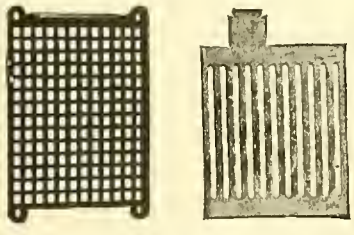
NEW DOUBLE POLE SWITCH.

on two of the corners have compressed the two springs and are just passing the highest point, when the contacts are about to be made or broken. Having passed this highest point, the springs press the rollers on the corners toward the center so as to rotate the switch through the part of the circle in which it travels. Owing to lost motion left in the spindle, there occurs instantly the make or break of the circuit with a sudden snap. The openings left in the side of the base facilitate surface wiring. The wires are held by a screw passed downwardly through the binding post, or, if preferred, the post is bored from the bottom up through the top, and the wires held by a binding screw passing through the side of the contact post.

Trial Trip of the Acme Storage Battery Company's Car.

On Wednesday, January 11th, the Acme Storage Battery company of New York made a trial trip of its storage battery car over the Ninth Avenue railroad from the stables at Fifty-fourth street and Ninth avenue to the upper end of the route, One Hundred and Twenty-fifth street, and back. On this road there is, for half a mile, a 6 per cent. grade. The car was one of the Stephenson type and carried 144 cells under the seats, divided in series of 12. The total weight of the batteries was 3 888 pounds, or 27 pounds each. The battery is the invention of P. Kennedy, of New York, and the motor was designed by W. M. McDougall, also of New York, and weighs equipped 2,360 pounds. The total weight of the car complete is 12,500 pounds. The trip was made without a hitch, and averaged 6 7-10 miles per hour in climbing the grade.

The grids used in the Acme cell, which are herewith illustrated, are of a non-conducting material, which, it is claimed, is not attacked by the acid and is sufficiently



TRIAL TRIP OF ACME STORAGE BATTERY COMPANY'S CAR.

elastic to yield to the expansion of the active material without buckling, warping or breaking. On the other hand, the active material is retained with sufficient firmness in contact with the conducting plate of lead in the middle of the complete plate. There is an equal amount of active material on either side of this lead conducting plate, thus insuring an equal distribution of current. Ribs on the non-conducting grids meet through slots in the conducting plate and are cemented together, making a solid plate. The openings for the reception of active material are smaller on the outside to aid in the retention of their contents. The exposed surface of active material is about 40 square inches on each plate, or about 200 square inches for the five positives. The maximum steady discharge in limbing the grade was 130 amperes.

There is a car now in course of construction with an 18-foot body to be sent to the Citizens' railroad of Chicago for experimental purposes. The officers of the Acme Storage Battery company are: G. C. Warner, president; W. H. Fletcher, vice-president, and C. T. Griffiths, secretary and treasurer, with offices at 29 Broadway, New York.

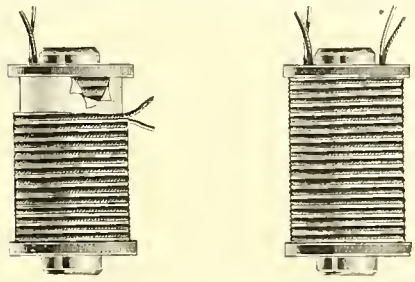
Varley's Method of Winding Electro-magnets.

It has for some time been the principal aim of inventors in the electrical field to improve the method of manufacturing so as to cheapen the cost of production without impairing the efficiency of apparatus. The electro magnet, which constitutes such an essential part of electrical apparatus, has not until the present time, it seems, been the object of the general improvement which has characterized the other departments, and it is made to day in substantially the same manner as it was when it first came into use.

Quite a departure from the usual method of making this piece of apparatus is that shown in Figs. 1 and 2, and is the invention of Richard Varley, Jr. It is called the duplex method, and has for its main object the doing away with the expense of using insulated wire exclusively, as is now the general practice. As magnet wire in certain sizes, such as used on the magnets of the most universally used apparatus, including bells, annunciators, telegraph instruments, etc., costs, if covered, about twice as much as bare wire would in the same sizes, it will be seen how much economy is effected.

In certain classes of apparatus where space is a very desirable element it has heretofore been impossible to condense the magnets without impairing their strength. With the duplex method it is possible to reduce the size very materially without decreasing the strength of a magnet, and this feature will probably be most appreciated by those who have to do with stock-tickers, railway signals, annunciators and telephone service in various ways.

The method of winding the duplex magnet is a novel one, two wires being wound simultaneously, one being covered, the other bare. The insulation of the covered wire serves the purpose of keeping the turns separated,



FIGS. 1 AND 2. VARLEY'S METHOD OF WINDING ELECTRO MAGNETS.

paper being used between each layer, thus bringing four ends out, which are connected in a simple magnet in series, or can, in the case where a differential circuit is required, be connected up very conveniently. The very nature of the method of winding makes it possible to have any combination of circuit that may be required, such as series, parallel or differential.

Fig. 1 shows a magnet in section, with a portion of the paper which insulates the layers from each other torn to show the construction, and Fig. 2 shows the electro magnet complete.

A magnet approaches its ideal efficiency when all the limiting space in the proximity of the iron core is entirely occupied by energizing current without any intervening air space. This, of necessity, is reached when the limiting space is only occupied by one turn, in which case no losses are due to insulation. When a departure is made from this theory the losses increase as the number of turns which have to be put on to get the required strength, due to a greater amount of insulation being needed. In other words, the available space for the wire around the core should be utilized as completely as possible, and therefore should contain no more non-conducting material than is absolutely necessary. The length of the wire should be as small as possible for the required number of windings and should be wound as closely as possible, as the more compact and uniform a magnet is made the greater will be its efficiency.

The Varley Duplex Magnet company of 136 Liberty street, New York, has been organized for the purpose of introducing this invention.

President Diaz of Mexico is said to own shares in every railroad, telegraph, telephone and electric light company in that country.

Canadian Electrical Association

The mid-winter convention of the Canadian Electrical association will be held at the School of Practical Science Toronto, Ont., January 25th and 26th. A number of interesting papers on timely topics are expected from members of the association. Among these are the following: "Electrical Measurements," by George Black, Hamilton; "Underground Construction," U. A. Tower, Toronto; "Free Wiring," J. M. Campbell, Kingston; "Incandescent Lamp," by R. G. Black, Hamilton; "Speed Control," Prof. Rosebrugh, Toronto; "Probabilities as to the Success of Distribution of Power at Considerable Distances by High Tension Currents of Electricity," by Mr. Breithaupt, Berlin, Ont.

In addition to the reports of the president, secretary and committees, there will be a discussion of the proposed amendments to the constitution. An invitation has been extended to the members to inspect the Toronto Electric Light company's new station. The Bell Telephone company's new exchange will also be thrown open for inspection.

National Electric Light Association.

The several passenger associations have granted an excursion rate of a fare and a third to delegates attending the convention of the National Electric Light association, to be held in St. Louis, February 28, March 1 and 2, 1893. To secure this rate it will be necessary for persons securing tickets to inform the agent from whom the purchase is made that they contemplate attending this meeting, and to procure from the agent a certificate which, immediately upon their arrival in St. Louis, should be left in the secretary's office, addressed to C. O. Baker, Jr., master of transportation, who will see that it is properly indorsed and returned to the owner. Arrangements are now being made for a special train from New York to St. Louis, which will exceed in the way of equipment and appointments anything that has ever been in service between these two points. To bring this matter to a successful issue, it is very important that the number of passengers who wish to avail themselves of this train should be known at the earliest possible moment. Therefore, it is very desirable, and will facilitate transportation matters greatly, if all delegates who contemplate using this train will make application for space at once.

Incandescent Lamp Litigation.

In the United States court at Chicago last Saturday application was made in behalf of the Edison Electric Light company and the Edison General Electric company for injunctions restraining the Sunbeam Incandescent Lamp company and the Illinois Incandescent Lamp company from manufacturing, selling or shipping incandescent lamps. It is claimed that the lamps made by these companies infringe the Edison lamp patents which were sustained by Judge Lacombe of New York in the Edison-Sawyer-Man litigation. Judge Grosscup granted a temporary injunction against the Sunbeam and Illinois companies, and named Saturday, January 21st, as the day upon which arguments would be heard.

Samuel Insull, president of the Chicago Edison company, said that the local company had not yet decided what policy it would follow. The Chicago Edison company has the exclusive right to sell Edison lamps in Cook county. The question of proceeding against consumers of incandescent lamps had not yet been disposed of by his company.

Proceedings have also been begun against the Columbia Lamp company of St. Louis.

Chicago Electric Club.

On Monday, January 16th, the Chicago Electric club held the first literary meeting of 1893, and discussed the subject, "Electric Meters." The number of members in attendance was not large, but the good and bad points in the various makes of electrical measuring apparatus were pretty thoroughly enlarged upon.

The literary committee had decided to make this meeting partake of the nature of an informal talk, and with this object in view had invited three members, John F. Gilchrist, P. J. McFadden and Chas. Wirt, to prepare short papers. Mr. Gilchrist selected the Edison meter as his subject, Mr. McFadden the Thomson meter and Mr. Wirt the Aron.

On January 11th Judge Shiras of Dubuque, Ia., issued an order for the sale of the Allen & Swiney electric street railway the first week in March. This order was made on the application of the Bay State Trust company, which holds a first mortgage for $200,000. There are other creditors to the amount of $100,000. It is expected that the Bay State company will buy it and operate the road.

CORRESPONDENCE.

New York Notes.

NEW YORK January 14.—While the recent snowstorms blockaded business generally in this city and Brooklyn and proved that the horse cars and elevated roads could not be depended upon under such conditions, the much maligned trolley demonstrated its superiority and supplied excellent service. Even the daily papers were compelled to admit that it had surpassed the expectations of its most ardent advocates. Concerning the operation of the electric lines the New York *Sun* says: "Under the old horse-car system residents of the annexed district were often obliged to walk to their homes on account of the blocking of the roads by storms of far less severity. This is the first real encounter the company has had with big snowdrifts under the trolley system, and the managers of the road are well pleased with the manner in which electricity conquered the storm. Yesterday each car was provided with small plows placed in front of the wheels. The plows did admirable service in keeping the rails clear of snow after the passage of the big snow plows which cleared the whole roadbed. In some parts of Brooklyn there were snowdrifts from six to twelve feet high, and the storm in some respects recalled the big blizzard. There was slight interruption in the regular traffic on the elevated and surface railroads, and the delays and inconvenience were mainly on the horse car lines. The railroad men all agreed that the trolley cars bore the strain admirably, and that they were run with scarcely any deviation from the schedule time. The storm, it was said, had clearly demonstrated the superiority of the trolley over horse power."

The Rapid Transit commissioners continue to listen to suggestions and arguments on the subject of providing accommodations for the people in the way of rapid transit. The fact that Manhattan stock continues to boom is looked upon as an indication that capitalists generally feel that the underground project is dead and that this company will have little or no opposition for some time at least. Representatives of labor organizations appeared before the commissioners at their last meeting and urged the advisability of the city building the underground road. It was claimed that such a course was the only practical solution of the problem.

The Brooklyn Traction company was incorporated Thursday with a capital $10,000, for the purpose of constructing street railways and equipping them with electrical and other power. The directors are E. D. Phillips, Albert Strauss, Henry S. Glazier, E. J. Kavanaugh of New York and P. J. Vaughn and J. H. Lockman of Brooklyn.

An interesting scene is reported in the daily papers in which $15,000 was bid for 20,500 shares of stock in the "United States Port Electric company." This concern was organized for the purpose of "transmitting parcels and mail matter by electricity." It is claimed that the system will be put in operation in Chicago during the World's Fair, between the city and the Exposition grounds. The stock deal referred to was not consummated owing to the fact that an injunction prohibiting the transfer was served on the auctioneer who attempted to dispose of the stock.

W. F. O.

Milwaukee, Wis.

MILWAUKEE, January 14.—The Milwaukee Street Railway company is having plans made for a car house and machine shop to take the place of the structure recently destroyed by fire. The new building will be the same size as the old one, 204 by 265, but will be a more attractive structure. The offices and conductors' room will be on the second floor, in the front of the building, and will be lighted by bay windows. The machine shop, which will be fitted with heavy machinery, will be put in the basement instead of on the first floor. It will have a 14-foot ceiling, and the store room will be located above it. Both the store room and the machine shop will be 75 by 175 feet, and they will occupy the southeast corner of the building. The car house will occupy the north half of the building, as it did before, and the car shops the south half. The new paint shop, across the street, will be built in a similar style.

H. C. Thom, chairman of the Republican state central committee, has become financially interested in the Four Lakes Power & Lighting company of Madison, and has been elected secretary and general manager of the corporation. The company furnishes Madison's electric lights, as well as the power for the street railway. It will extend its business as soon as possible. The company, it is said, represents a combined capital of $3,000,000.

At the coming session of the Legislature a bill will be introduced to provide for the establishment by the state of an electric lighting plant at the capitol building. Capt. Vance, the assistant superintendent of public property, asserts that the carrying out of the project will result in the saving to the state of more than the interest on the money required to purchase and operate the plant. The gas used by the state costs $5,000 per annum. It is thought that there will be little opposition to the project.

In Milwaukee, where he is interested so extensively, little credit is placed in the report that Henry Villard will be a member of President Cleveland's cabinet. The report that coupled Villard's name with a portfolio had it that he had disposed of his holdings in the Milwaukee Street Railway company. Henry C. Payne, one of Villard's representatives in the city, denied both reports in a most emphatic manner. Edward C. Wall, Villard's other representative here, who is a member of the Democratic national committee as well, makes just as strong a denial. He says that the report about Villard having sold out probably originated in the transfer of the power house and other apparatus from the Edison company to the Milwaukee Street Railway company. The transfer, Mr. Wall said, was made about two weeks ago, and it might easily have been mistaken for a transfer by Villard himself. Mr. Wall said that Villard probably represented fully $200,000,000 of foreign capital in this country.

Judge Johnson of the Circuit Court has issued an orde referring all claims against the Milwaukee Electric Railway company, commonly known as the Hinsey line, to Court Commissioner Hugh Ryan. Receiver Melms has filed a statement showing the financial condition of the road. Mr. Hinckley, the Chicago stockholder, is still credited with making determined attempts to prevent the sale of the road at too low a price. Talk of a local syndicate buying it is not credited.

Prof. H. B. Loomis of the Wisconsin State University gave a very interesting talk in the rooms of the Wisconsin Electric club last week. His subject was "Protection from Lightning." Several experiments were made, a Holtz machine being used to represent the discharge of lightning. The lecturer took the position that the ordinary lightning rod protection was not much protection after all, and that to thoroughly protect a building or a high chimney it would be necessary to use the wire cage form of protection, which would mean to surround the building or the chimney with a number of wires leading to the earth. The lecturer made another point—that the cross-sectional area of the rod does not enter largely into the question of protection, and that a flat band of copper is just as good a conductor as a round bar of copper.

At Appleton the street railway people are trying to boom their business by giving $5 to the motorman whose car carries the largest number of passengers during the month.

Wausau is talking of putting in an electric lighting plant.

The new telephone line between Marshfield and Mc Millan is now in use.

At the last meeting of the Sheboygan aldermen the Wisconsin Telephone company asked for a franchise to maintain a telephone system. About ten years ago the company installed a plant at Sheboygan without securing a franchise, and it is reported from that burg that the expiration of telephone patents in the near future has something to do with the company's application for a franchise.

The Oconomowoc electric power house is being built rapidly. In order to secure a basis upon which to figure, the company recently sent circulars to owners of property around the lake asking them to estimate the number of lights that they would probably need. The responses greatly exceeded the expectations of the projectors.

Mayor Jackson I. Case of Racine has withdrawn his resignation in consideration of satisfactory action by the Common Council on the question of his holding stock in the electric railway in that city.

Mrs. M. E. Dey, 60 years old, was run over and killed by an electric car at the corner of Holton and Center streets last Sunday. She was somewhat deaf, and did not hear the car. The motorman was exonerated from all blame.

C.

New England Notes.

BOSTON, MASS., January 14.—The electric car rolls rapidly along in New England, and now some enthusiastic men in Maine are figuring how they can complete a through route from Boston to the heart of the Pine Tree state. These gentlemen are mostly located in the thriving city of Auburn. They are: Albert M. Penley, J. W. Mitchell, W. W. Stetson, W. B. Beals, George E. McCann, W. G. Lowell, J. R. Learned, D. W. Verrill, F. T. Faulkner and Ara Cushman. They have given notice that they intend to apply to the legislature this winter for a charter which will allow them to build a line from Auburn to Livermore. They expect the freight business will go a great way toward paying the operating expenses of the road. The country through which the line would pass is a thriving farming and manufacturing community. The town of Turner ships annually about 15,000 barrels of apples, which now have to be hauled to Auburn by teams. Turner village has a big woolen mill and large saw and grist mills, the products of which have to be hauled in the same manner as well as all its supplies. At Turner Center is one of the best and biggest creameries of the state. The charter will name Livermore as the terminus, but the road will be constructed only to Turner at first. Another body of projectors, including many of the same men, will also ask for a charter for an electric road from Auburn to Mechanic Falls. This one would not be used so much for freight, but would be expected to do a good local express business. J. R. Learned is very enthusiastic over both these projects. He predicts that within five years there will be a continuous line of electrics from Boston to Bangor. There are already lines from Boston to Lynn, and these will soon be extended to Gloucester. There is an electric road at Newburyport, one from Dover to Great Falls, N. H., from Biddeford and Saco to Old Orchard, from Portland to Woodford's, from Gardiner to Hallowell and Augusta, and one at Bangor. It would only require the filling in of the connecting links to make a continuous road. Mr. Learned says his companies will make an attempt to use some kind of a storage battery. The petition of the Lynn & Boston Street Railway company to extend its tracks to Beverly has been acted upon favorably by the Beverly selectmen. They have voted to call a special meeting of the town to act in the matter. There is little doubt that the request will be granted. So link by link Boston's electric communication with the surrounding country is being extended.

The electric road from Rockport to Pigeon Cove will probably have to be abandoned, as it seems impossible to get permission to do a freight business over the public highway.

Lowell will soon have an electric line connecting with the seaboard. The Lowell, Lawrence & Haverhill Street Railway company is about to absorb the Haverhill & Amesbury road, which runs to Salisbury and Newburyport. This is the last of a series of operations by which a Thomson-Houston syndicate has acquired a through line to the ocean from Lowell. Track is all laid except two small sections, one between Lowell and Lawrence, and another between North Andover and Bradford, where locations have been obtained. The syndicate will operate a line 60 miles in length. It will establish a series of parks and picnic grounds along the route. It has already bought one grove in Lawrence and another in Groveland. This syndicate also operates lines in Norwich and New London, Conn., the South Shore line and some in Maine.

A two-million dollar fire on Summer street in the wool district caused the West End Street Railway company of this city considerable expense Tuesday, as it was obliged to cut down a great deal of its overhead wires in that section. The West End company has a well organized emergency corps whose business it is to be on hand on such occasions. They did not arrive at the fire Tuesday for a quarter of an hour after the firemen, but the delay was not their fault. President Whitney has time and again asked the city authorities to put electric tappers in their emergency stations on which they could receive the fire alarms as soon as the firemen. This has not been done, but it is probable that the object lesson of Tuesday will cause it to be done soon. If the West End men had been on hand sooner they could have given the fire fighters great assistance in taking care of the wires which hindered the erection of ladders upon the burning building.

J. C. E.

PERSONAL.

S. W. Hume has been appointed western manager of *Power*.

Lewis Degen, electrician of the Denver Tramway company, Denver, Colo., was in Chicago last week.

J. Austin Young, representing the Bickford & Francis Belting company of Buffalo, was in Chicago last week.

Paul G. Fuller, manager of the Boston Braid Manufacturing company, of Boston, was a visitor at the New York office of the WESTERN ELECTRICIAN last week.

W. F. Richardson of the Enterprise Electric company, Chicago, has recovered from a severe sickness which has necessitated his confinement to the house for the last two weeks.

NEW INCORPORATIONS.

Pierce Construction company, Leominster, Mass.; capital stock, $9,000; to construct electric railroads and manufacture electric railroad supplies.

Oreville Light, Heat & Power company, Oreville, O.;

capital stock, $20,000; furnishing electric light, heat and power; J. A. Wagner, Canal Dover, O.

Inter-State Electric Light & Power company, Colorado Springs, Colo.; capital stock, $100,000; to operate and maintain electric power plants and machinery and appliances of all kinds.

Star Electric company, Dubuque, Ia.; capital stock, $100,000; to manufacture and supply electricity, gas or steam for light and heat; Henderson, Hurd, Daniels and Kassell, Dubuque, Ia.

Beattie Zinc Works company, Reading, Mass.; capital stock, $10,000; to manufacture and sell battery zinc and other electrical supplies; Arthur Lord, 53 State street, Boston, Mass.

Central Colorado Electric Supply & Manufacturing company, Pueblo, Colo.; capital stock, $100,000; to deal in electrical goods and supplies of all kinds; to do electrical construction work, etc.

Everett & Snohomish Street Railway company, Everett, Wash.; capital stock, $100,000; to build, construct and operate railways, whether steam, electrical or otherwise; Black & Edwards, Snohomish, Wash.

Columbia Heights Electric company, Columbia Heights, Ill.; capital stock, $25,000; electric light and motor purposes for Columbia Heights, Cook county, Ill.; C. M. Sherman, 95 Dearborn street, Chicago, Ill.

Effingham Electric Light & Power company, Effingham, Ill.; capital stock, $15,000; to furnish light and power for sale to municipal and other corporations and individuals in Effingham and suburbs; Wood Bros., Effingham, Ill.

Electrolier Manufacturing company, Newark, N. J.; capital stock, $100,000; to manufacture and sell light adjusters, call bells, signals and electrical implements and apparatus; B. E. Chapin, 37 Limbardy place, Newark, N. J.

Cloquet Light & Power company, Cloquet, Minn.; capital stock, $50,000; to manufacture and sell electric light and power; the establishment of lines, poles, wires and lamps and other appliances for transmission; W. P. Allan, Cloquet, Minn.

Eastern Engineering & Construction company (incorporated in W. Va.) Philadelphia, Pa.; capital stock, $500,000; building and equipping electric light plants; electric railways, etc.; W. C. Hannis, 526 Drexel building, Philadelphia, Pa.

Excelsior Electric Signal & Manufacturing company, South Omaha, Neb.; capital stock, $50,000; to purchase, own and operate certain patents which have already been granted by the United States to wit: Nos. 446,546; 447,943; 460,464; 466,520.

Commercial Light & Power company, Duluth, Minn.; capital stock, $500,000; to construct and operate plants; manufacture and deal in electrical appliances for the production of electricity for light, heat and power; deal in all appliances and fixtures, also to manufacture and operate gas plants; Nash, Williams & Chester, Duluth, Minn.

East St. Louis Belt Suburban Dummy or Electric Railway company, East St. Louis, Ill.; capital stock, $500,000; to construct dummy or electric railways upon, over and across streets, alleys, viaducts, etc., in East St. Louis, and extending through and from East St. Louis, Carondolet, Cahokia and Brooklyn, in St. Clair county, to Venice and Madison in Madison county.

ELECTRIC LIGHTING.

The Newcastle, Ind., council has decided to put in an electric light plant.

A proposition to light the town of Georgetown, Tex., with electricity is being agitated.

A canvass of Charlevoix, Mich., is being made with a view of establishing an electric light plant.

The proposition to bond Madison, Neb., for an electric light plant is to be submitted to the electors.

The Milford, Mich., Electric Light company has been granted a franchise to put in an electric light plant.

Harvey Hunter contemplates putting in an electric plant to light the towns of Mellette and Northville, Iowa.

The newly inaugurated mayor of Atlanta, Ga., recommends that the city put in its own electric lighting plant.

The city council of Kendallville, Ind., has passed a resolution providing for the establishment of an electric light plant.

The Bailey Electric Light company has secured a five-year contract from the city of Dillsburg, Pa., and will put in a new dynamo.

The town of Sauk City, Wis., is considering a proposition to join Prairie du Sac in an electric light plant to furnish light for the two towns.

The Electric Light company of Dalles, Ore., has purchased a tract of land, on which new works will at once be erected of greatly increased capacity.

The Electric Railroad company of Denver, Colo., wants the city council to grant it the privilege to take down all incandescent lights and towers, and substitute arc lamps.

A petition from W. H. Sinclair for a franchise to furnish light and power to the citizens of Galveston, Tex., is in the hands of the council committee on lights and the committee on ordinances.

ELECTRIC RAILWAYS.

A street railway is projected at Rock Falls, Iowa.

The Terminal company of Superior, Wis., will build a road to Tower Bay Slip.

The Natchez, Miss., Street Railway company has been granted a franchise to construct and operate an electric street railway. The road will be built at once.

A franchise has been granted by the city of Guthrie, Okla., for an electric street railway, and a company has been formed to carry out the work. It is intended to commence work at once on the construction of three miles of road, and to extend it from time to time as the needs of the town require.

On the Budapest electric conduit railway fifty cars are now in operation. In crowded streets the speed is limited to six miles an hour, some places even as low as three miles, but in outside districts the line is usually run at an average of nine miles an hour. Cars are run 16 hours per day and make a daily record of from 70 to 90 miles.

The Rochester Street Railway company has purchased a 500 horse power engine, two generators of 250 horse power each, and a condenser. The engine was made by McIntosh & Seymour, of Auburn, and the generators are from the Short company of Cleveland. The total capacity of the engines will now be 25,000 horse power.

The trolley is no longer an experiment for city transit, says the *Philadelphia Record*. It has incontestably demonstrated its superiority to other modes of surface travel in this city, under the severe test of an uncommonly hard winter; and one of the first results of the success of the Baimbridge and Catherine streets line has been the culmination of a project to build a trolley road from Manayunk to Roxborough. The revolution in urban transportation has begun, and it is not going backward.

The Englewood & Chicago Electric Street Railway company of Chicago has been incorporated. The five incorporators named are James P. Mallette, David D. Chidester, George C. Lazear, William H. Comstock, and F. W. Pringle. Mr. Chidester gives the following information: "The capital stock is to be $1,000,000, divided into 10,000 shares of $100 each, and it will nearly all be taken as soon as the books are opened for subscriptions. Work will be pushed as soon as the preliminary arrangements are effected. The length of the line and its direct course I am not at liberty to give at present, as negotiations must first be completed for certain tracts of land. In general terms, however, I can say that Mr. Armour, Mr. Pullman and other large land-owners will be interested. The design is to afford rapid transit to a section which has now no direct lines of communication with the city. The road will probably be extended to the state line of Indiana, with a cross line or feeder on Ninety-fifth street. We shall work in harmony with the Calumet lines. No, we have not decided upon any particular electric system, but are making investigations and shall continue to do so until we are able to select such a system as combines all the latest and best methods applicable to safe, rapid, and economical transportation. So much is yet to be done in securing right of way and other privileges, as well as land for terminal stations and shops, that I am not at liberty to give any more definite information as to our plans. We shall, however, endeavor to run far enough north to furnish our patrons with as good transportation between their homes and places of business as is possible."

TELEGRAPH.

The war department has issued an order for a new flying telegraph line from Fort McIntosh, Tex., to insure quick transmission of messages from the seat trouble on the Mexican border, and Lieut. J. E. Maxfield, of the Signal Corps, has been directed to proceed with its construction.

Chief Ramsay, of the Order of Railway Telegraphers, states that all differences between the operators on the Big Four and the officials of the road have been amicably adjusted, and like results have been achieved on the Wabash line. In the former case the increase of pay to the telegraphers amounts to $24,000 a year. The increase to the employes of the Wabash line has not been calculated.

The annual report of the telegraphs in Belgium has recently been issued. During 1891 5,413,916 telegraphic messages were dealt with, as compared with 5,312,295 in 1890. At the end of 1891 there were 1,595 telegraphic offices in the country, and the length of the wires amounted to about 23,075 miles. There were thirty-three state telephone offices in operation throughout Belgium, to which there were 6,980 subscribers.

The Chicago police telegraph operators are making an endeavor to secure a raise in their salaries, and the privilege of taking a vacation once a year. A meeting was recently held at the Harrison street police station and a permanent organization formed. It is the desire of the 105 operators employed by the police department to have their present salary of $60 a month increased to $75. For some time a petition has been in circulation and is now in the hands of Chief McClaughrey, who, it is said, has promised to recommend the passage of the measure.

An Ottawa dispatch states that the Dominion government has taken action in regard to the memorials from Canadian boards of trade urging the appointment of a special commission to inquire into the most feasible means of completing the telegraphic system within the empire, including a cable from British Columbia to Australia. The secretary of state in reply has announced that copies of all the documents have been forwarded to the imperial authorities with an intimation that the Canadian government would view with satisfaction the appointment of a commission as named, and would gladly send and bear the expenses of a delegate to act upon such commission. The estimated cost of the trans-Pacific cable is $10,000,000.

The Order of Railway Telegraphers, in its conference with the Baltimore and Ohio officials in November last insisted that no operators should be paid less than $45 per month and the officials agreed with this view, but urged the committee to reflect that if the pay of an operator was placed at $45 as the minimum the result might be disastrous to many operators, as there were at least 30 per cent. of the smaller offices where the telegraph department could remove its instruments from the office without detriment to the service, and that according to the proposed rule, as the operator could not work for the company as an agent alone, he would in all probability be thrown out of employment entirely. The new schedule went into effect December 1st, and during last month the agent operators made considerable extra money. The pay-rolls were sent to the division superintendents at the end of the month, and when those officers examined the details they were astounded at the increase. Then the superintendents became dissatisfied, and in about one-third of the smaller offices the instruments were removed, and the operators discharged. Then men who knew nothing about telegraphing, but who were able to discharge the duties of ticket agent were employed at rates of pay which prevailed before the new schedule went into effect. Unless the brotherhood recedes from its regulation a number of other agent-operators will be dismissed.

MISCELLANEOUS.

Tekoa, Wash., is said to be the smallest town in the world with electric lights, water works and a telephone exchange.

Caryl D. Haskins, manager of the meter department of the General Electric company, will lecture before the Boston Young Men's Christian association on March 11th, his subject being "Electricity in the Service of Man."

A German savant proposes to disinfect the Elbe and other rivers by means of electricity. He claims that an electric current passed through the water will cause a chemical change that will kill cholera and other germs. He says that sewers can be disinfected in a similar manner.

All trains leaving the Dearborn station in Chicago are started by the sound of an electric bell. The system is a new one in railway stations of this country. A large clock in the train dispatcher's office is electrically connected with large gongs in the different waiting-rooms and in the train shed. Two minutes before the train starts the different gongs ring in all parts of the building.

Dr. Lewis Swift, the noted Rochester astronomer, is still objecting to electric street lamps. "We have decided two things," he said in a recent interview, "first, that the streets can be lighted as brightly and as cheaply as at present without interfering with our observations; second, that the only way to secure such lights is by compelling the companies to introduce them. I wish laws might be passed to that effect, but I am not sanguine enough to believe that they will be. If, however, it can be shown that what is an advantage to those interested in astronomy will also aid the electric companies, the thing is as good as done. Therefore, we are bending our efforts toward the invention of such a plan."

Dr. Nansen's late lecture before the British Geographical society bristled with ingenious devices for passing away the time during which he expects to be ice-bound and to drift with the floes toward the much-sought pole. So many of these devices are dependent on the supply of electric current that henceforth no well-equipped arctic expedition will be considered complete without its dynamo. It is easy to imagine how cheering will be the effect of the electric light on those whose perilous task will subject them for some months to almost total darkness. Dr. Nansen's proposed method of generating electricity is at all events original, although somewhat deficient in the quality of reliability. He proposes to have a windmill on deck to drive the dynamo, and when the wind fails to let his men take turn-about at a "walk-mill," in order to afford them such salutary exercise as might be involved in heaving imaginary anchors. If this method of generating current should prove effective it is but natural to believe that it will hasten the general adaptation of treadmills in prisons to the generation of electricity.

At a recent meeting of the city council of Westport, Kan., an application for the electric lighting franchise was made by the Kansas City Electrical Works. This company wanted a franchise for twenty years and offered to furnish the city sixty all night arc lights for $8 a month, or 100 thirty-two candle power incandescent lights for $26.50 a year. The company offered to furnish sixteen candle power incandescent lights to private consumers for three-quarters of a cent an hour, provided the bill for each month was not less than $3. The city offices were offered free light and it was provided that the city should have the privilege of buying the plant at the end of five years. The matter was referred to the lighting committee. This committee now has a straight proposition to build for the city by the Fort Wayne Electric company, and Thomas Wolf's proposition to lease a plant from the city. The committee will probably recommend that all propositions be rejected and that the city call a special election and vote $35,000 bonds and then have the city build and operate its own plant. Alderman McMillen, a member of the committee, says that 200 private consumers will probably take the light and that the city would thus have an income of at least $1,200 a month.

TRADE NEWS.

George Cutter, Chicago, is perfecting a new socket for use in mines and tunnels.

C. S. Knowles, Boston, representing the Tenax splicing compound, has added to his stock of specialties "Insullac" manufactured by the Massachusetts Chemical company.

Harry Bishop, formerly eastern representative of the *Street Railway Gazette*, Boston, has been appointed agent of the Massachusetts Chemical company with office at 823 Monadnock building, Chicago.

Cushing & Morse, 225 Dearborn street, Chicago, report business as excellent during the last month and an increasing number of orders coming in all the time for the popular Kerite wires and cables, for which they are general western agents.

The New York Insulated Wire company, of New York, manufacturer of the celebrated "Grimshaw" wire, will be represented in Boston by Walter S. Barker, with offices at 182 Summer street. A full line of wires, cables and tapes, will be carried.

The Varley Duplex Magnet company is the name of a new concern in the Electrical Exchange building, New York, which will commence to manufacture a new electromagnet, invented by Richard Varley, Jr., which is quite a departure from the ones now in vogue. A detailed description of this invention is given in this issue.

The Electric Appliance company, Chicago, reports large sales of Paraolte wire. Two large hotels, the Gault house and the New Briggs house, Chicago, have just been wired throughout with Paraolte wire, while several more large buildings are now being wired and contracts to supply Paraolte for a number of others have been closed.

In the office of Thos. G. Grier, agent for the Bryant Electric company, Chicago, the stenographer, in addition to a lunch brought from her home, enjoys a warm drink of coffee boiled by electricity. Every day as the noon hour approaches, a three pint coffee pot is placed on the little Carpenter heater, and in a few minutes the coffee is steaming away as if it was on an ordinary cook stove.

Col. L. G. Burnham, manager of the Electric Gas Lighting company of Boston reports business brisk and showing fully one-third increase during the year. The company having outgrown its old quarters has moved to a point on Dover street near Harrison avenue where it has three times the capacity for manufacturing. It has also added largely to its machinery. The company will make a specialty of manufacturing burners, cut-outs and a large line of electrical appliances.

W. H. McKinlock, president of the Central Electric company, Chicago, left last week for a short trip to New York, with the intention of making arrangements for the spring trade. The business of this company for the last year has been a very large one, and everything indicates that the spring trade will be far in excess of any previous season. This company has recently placed the Interior Conduit & Insulation company's system of tubing and ducts in several large buildings in Chicago, St. Louis and other western cities, including the Newberry Library building, the new Athletic club and Congress Hall.

G. S. Searing, 1417 Monadnock building, Chicago, has taken the western agency for the Hart switches, which are manufactured by the Hart & Hegeman Manufacturing company, Hartford, Conn. These switches are well known to the trade. Another specialty which Mr. Searing will handle will be the St. John adjustable shade. Mr. Searing has been representing the National Electrical Manufacturing company of Milford, Conn., which makes specialties of telegraph instruments, A. D. T. gongs, bells, annunciators and other electrical house fixtures. His connection with the last named company will continue, and the new lines of goods will be handled in Mr. Searing's usual energetic manner, in conjunction with the National company's specialties.

Angier & Kennard have opened offices at 519 Monadnock building, Chicago. This firm has been appointed general western representative of the Butler Hard Rubber company, the New York Rubber company and F. H. Lovell & Co. of New York city. It is their intention to handle the goods of these concerns for the western territory, and they will make Chicago the distributing point. They have found a large demand for the goods they are carrying, and they are prepared to furnish everything in the rubber line demanded by the electrical trade. The members of this firm, Edward Angier and Frank Kennard, are energetic young men well known to the trade, and they have excellent facilities for handling this business. Their personal attention will doubtless insure an increase in the volume of western business.

A catalogue of special machinery has just been received from the Link Belt Machinery company of Chicago. This tasteful little pamphlet, compiled under the direction of O. W. Russell, contains some interesting information to those figuring on link-belt labor saving devices of any sort. Without going into detailed description of the matter presented, it may be said that numerous handsome illustrations are presented, showing the applicability of link belting in conveying work of all kinds. The Link Belt company is making a specialty also of rope transmission systems, and electrical men contemplating installations of such systems, or in fact any arrangement in which link belting might be used to advantage, will find it to their interest to drop a line to the company for its catalogue of special machinery as well as other valuable information.

BUSINESS.

The Central Electric Company, Chicago, is installing a two horse power Lundell motor at Ellinston Bros. & Co., 149 Fifth avenue, Chicago, to operate sewing machines.

The Lundell motors, up to 5 horse power, which have recently been put upon the market by the Interior Conduit & Insulation company of New York, and which are being introduced in the West by the Central Electric company, are meeting with a ready sale, and the Central Electric company has already installed several of them in its territory.

B. F. Stewart has just returned from Shreveport, La., where he closed a contract for the Westinghouse Electric & Manufacturing company with the Shreveport City Railroad company for four car equipments. McGuire trucks will be used. Mr. Stewart has also just sold the South Chicago City Railway company 21 additional Westinghouse double motor equipments.

Charles E. Gregory, so well known in Chicago and elsewhere throughout the West as a dealer in electrical machinery which "has seen some service," has formed a company to carry on his rapidly growing business. The new organization will operate under the name of the "Chas. E. Gregory company," with Mr. Gregory as president and treasurer. The new concern is capitalized at $50,000.

The Chicago Incandescent Light company is still running full blast. This concern manufactures incandescent lamps, 50 to 125 volts, as wanted. Thomas Pray, Jr., general manager and electrician of this company, said to a representative of the WESTERN ELECTRICIAN on Monday of this week: "We have received no direct information as to what position the General Electric company will take relative to our lamp business. We acknowledge the validity of the Edison patent, however, and are awaiting the General Electric company's decision."

Business in electrical repairs in Chicago is, according to James McLean, quite brisk at the present time. Mr. McLean is one of the firm of McLean & Schmitt, which makes a specialty of all sorts of electrical repairing and general contracting. The firm have now under way several good contracts and are employing quite a number of men. Both Mr. McLean and Mr. Schmitt were with the Excelsior Electric company, and are handling along with their repair work carbons and supplies for the Excelsior system. The firm's factory is at 416 Warren Springer building, 197 South Canal street, Chicago.

The Railway Equipment company, Chicago, reports an unusually large business for this time of the year. Several important contracts have been closed during the last two weeks, and the company has on hand large deals for the coming season. The "Type G" overhead materialf brought out by the company the early part of the last season is growing in popularity and is giving the best of satisfaction. The company has also done a large business with the Ahearn electric heater. General Manager W. R. Mason is an enthusiast on the subject of electric heating and cooking and promises great things for the future in this branch of the business.

The entire plant of the Fort Scott Foundry and Machine Works, established at Fort Scott, Kan., in 1869, and owned by the Walburn-Swenson company, is now being removed to Chicago Heights, Cook county, Ill. During the last few years a large trade for the special lines of improved machinery manufactured by this company has been established throughout the eastern and middle states. The company has erected new brick buildings on the same general style as the works at Fort Scott, but of twice the size, and with the new machinery will more than double the present capacity. The general office of the company will be at No. 1520 Monadnock block, Chicago. The works at Chicago Heights are located on the Belt Line, Elgin & Joliet railway, Chicago, Eastern Illinois & Indiana railway, and the Michigan Southern railway. The eastern office will remain at 31 and 33 Broadway, New York.

ELECTRICAL PATENTS.

Issued January 10, 1893

489,551. Electrical Diaphragm. Charles N. Waite, Newton, Mass.

489,553. Electric Switch. G. Baehr, Brooklyn, N. Y.

489,559. Galvanic Battery. George L. Foote, Brooklyn, N. Y.

489,563. Electric Railway. Daniel E. Kimball, Topeka, Kan.

In connection with a continuous electric conductor, a bare sectional conductor is used in combination with a series of rock shafts arranged at right angles to the continuous conductor; the rock shafts being directly connected at one end with the continuous conductor, and the other end projecting into a conduit, where it is provided with a crank arm adapted to close circuit to the sectional conductor.

489,570. Spring Jack Switch. Charles E. Scribner, Chicago, Ill.

The line spring bearing upon its contact point acts to press from its contact point a second spring which closes circuit to the test piece. On the insertion of a plug the line spring is raised from its contact point, permitting the test spring to close upon its contact.

489,431. Electric Railway Trolley. Ernest H. Jenkins, Winfield, Md.

The trolley wheel is carried upon a yielding arm upon the end of the trolley pole, so that the rocking of the pole upon its pivot does not result in lifting the trolley wheel from the trolley wire.

489,505. Journal Bearing for Dynamo-electric Machines. William L. Silvey, Lima, O.

489,522. Galvanic Battery. William C. Cahall, Philadelphia, Pa.

The negative element is composed of the oxide of antimony intimately combined with carbon.

489,526. Electric Lighting System. Harry M. Doubleday, Pittsburg, Pa.

A reactive coil is wound with several sections of wire, the several sections each being connected with terminal points provided at two or more lamps. Contact arms are provided at each of the lamps, and can be moved over the terminals to throw the lamp into circuit with more or less of the sections of the winding of the reactive coil, thus regulating the intensity of a number of lamps by means of a single reactive coil.

489,571. Spring Jack Switch for Telephone Exchanges. Charles E. Scribner and William R. Patterson, Chicago, Ill.

489,573. Conductor System for Electric Railways. Georg W. Von Siemens, Berlin, Germany.

A contact conductor is composed of a series of relatively insulated sections, normally interrupted connections being provided between the insulated sections and the supply conductor. An electro-magnetic device is provided for each contact section, the armatures being adapted to be successively operated by a magnetic device on the vehicle to close the circuit through the magnetic devices to complete the interrupted supply connection of the section into which the vehicle is moving and interrupt the corresponding connection of the preceding section.

489,597. Multiphase Railway System. Francis B. Badt, Chicago, Ill.

The system comprises three supply conductors and a series of sectional conductors. At each section a series of converters is provided, the primaries being permanently in the generator circuit. The secondaries are in circuit with three parallel sectional conductors, the connections between the secondaries and the sectional conductors being normally open. The vehicle carries trolley wheels adapted to engage with each of the three sections to convey the tri-phase current to the motor upon the vehicle, means being provided for automatically connecting the secondaries of the converters with the sectional conductors as the vehicle passes upon the section.

489,598. Electric Lighting System. Francis B. Badt, Chicago, Ill.

Three lamps are connected in series, and the three conductors of a three-phase system are connected between the lamps, one conductor being connected between each pair of the lamps, so that the lamps will alternately rise to a maximum brilliancy.

489,603. Attachment for Telephones. James L. Davidson, Pittsburg, Pa.

489,616. Electric Gas Lighting Apparatus. Aaron M. Sloss, Kansas City, Mo.

The spark coil and battery are placed in a receptacle provided in a chandelier, and connected with the circuit breakers at the different jets, expensive wiring being thus obviated.

489,625. Electrically Controlled Ventilator. Sebastian G. Brinkman, New York, N. Y.

489,629. Railway Signal. William F. Z. Desaut, New York, N. Y.

489,653. Electric Gas Lighter. Thomas W. Lane, Boston, Mass.

489,658. Strain Insulator. Louis McCarthy, Boston, Mass.

489,668. Electric Battery. Clarence H. Bryan, Chicago, Ill.

The excitant compound of the battery, which is of the class known as dry batteries, comprises a mixture of a salt of calcium, a ferrous salt and a salt of mercury.

489,682. Lamp Socket. Amandus Metzger, Schenectady, N. Y.

489,687. Means for Controlling Electric Motors. John F. Ott and Arthur E. Kennelly, Orange, N. J.

489,704. Electrotype. William T. Barnum, New Haven, Conn.

489,709. Variable Speed Electric Motor. Carl Hering, Philadelphia, Pa.

489,674. Loop Switch. Frederick D. A. Goold, Schenectady, N. Y.

489,709. Variable Speed Electric Motor. Carl Hering, Philadelphia, Pa.

The variable speed motor comprises two separate motors having their armatures mounted upon the same shaft, the field magnet of one motor being fixed while that of the other is mounted so that it may rotate about the armature axis. The pulley from which the power is obtained is carried by the rotating field magnet. By properly varying the strengths and direction of the currents supplied to the motors the rotating field magnet may be caused to rotate at any speed from zero to twice the speed of the armatures.

489,736. Railway Signal. John E. Geary, Syracuse, N. Y.

489,738. Washing and Sizing Machine. Eugene G. Hammond and Edward D. Hammond, Hanover, Ill.

489,739. Socket Switch for Incandescent Electric Lamps. Louis Henry and Louis N. Dalyssoo, Newark, N. J.

489,764. Underground Electric Railway. Jas. B. Sheldon, Daniel J. Murnane and George L. Van Beek.

The railway comprises a main supply conductor, a pivoted switch provided with an exposed contact, and consisting of a hermetically sealed box with contacts so located that when the switch is in its normal position the exposed contact is out of circuit with the main supply conductor, but when the switch is actuated the exposed contact is brought into electrical connection with the main supply conductor.

489,790. Non-magnetic Watch Balance. Charles F. Carpenter, Louisville, Ky.

489,815. Hanger for Electric Lamps. Charles S. Hume, Detroit, Minn.

489,832. Galvanic Battery. William R. Reud, New York, N. Y.

489,835. Closed Conduit Electric Railway. Charles A. Stark, Duluth, Minn.

A compressible rail is provided, and is adapted to close the circuit through a surface conductor with which the trolley is in contact.

489,861. Bracket for Electric Light Wires. George H. Bennett, Cincinnati, O.

489,883. Electric Car Truck. Thomas Tripp, Avon, Mass.

489,902. Electric Prison Cell and Guard. William S. Hull, Sheffield, Ala.

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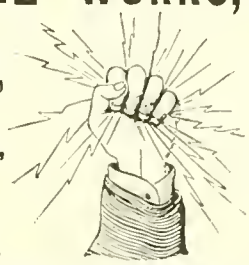

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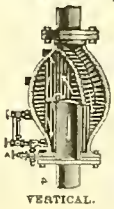

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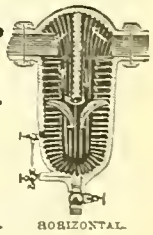

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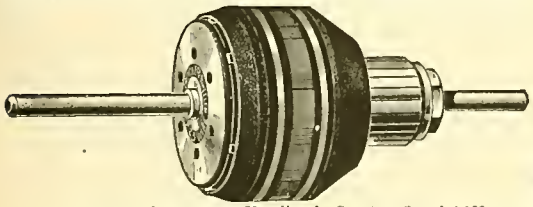

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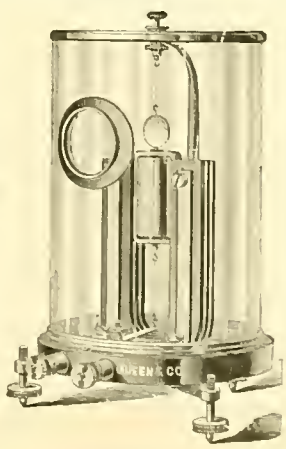

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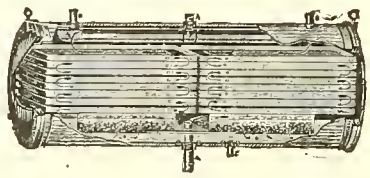

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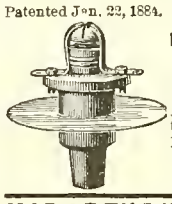

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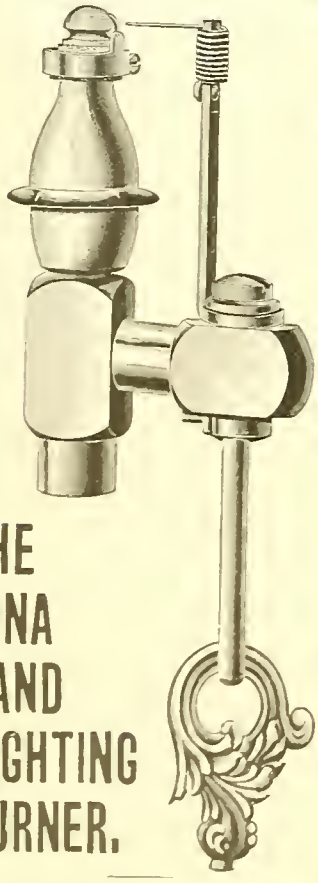

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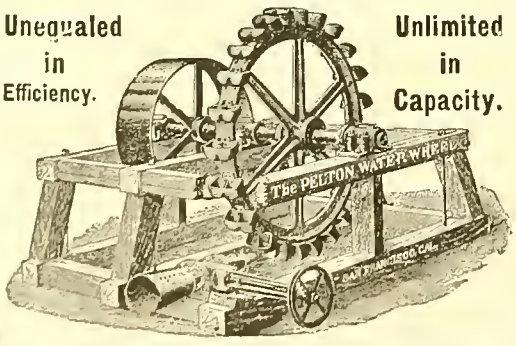

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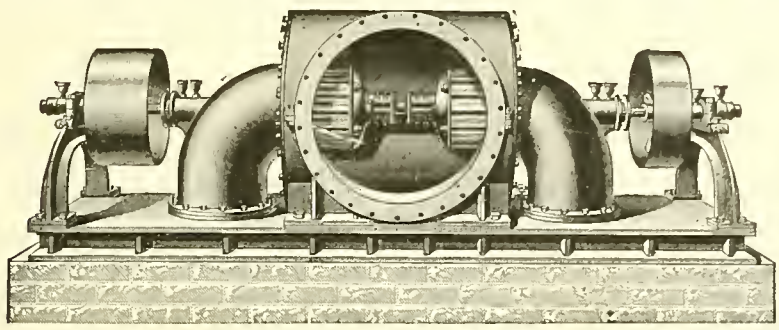

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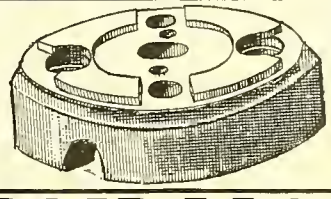

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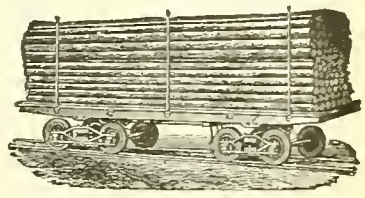

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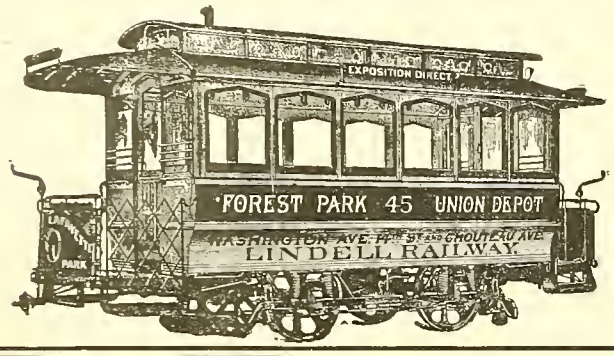

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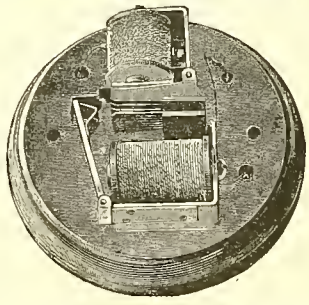

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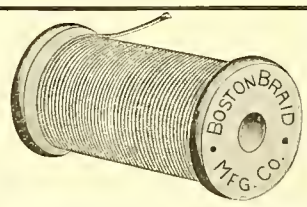

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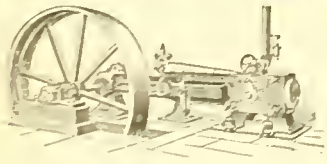

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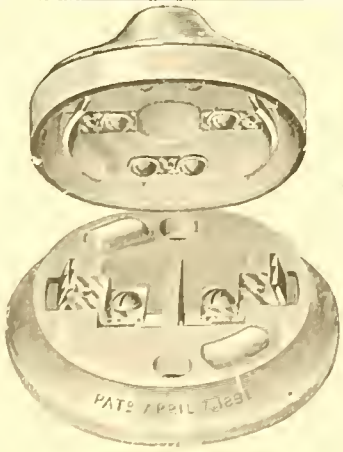

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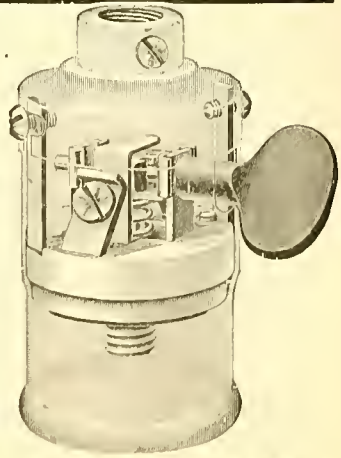

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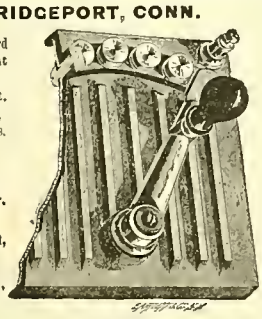

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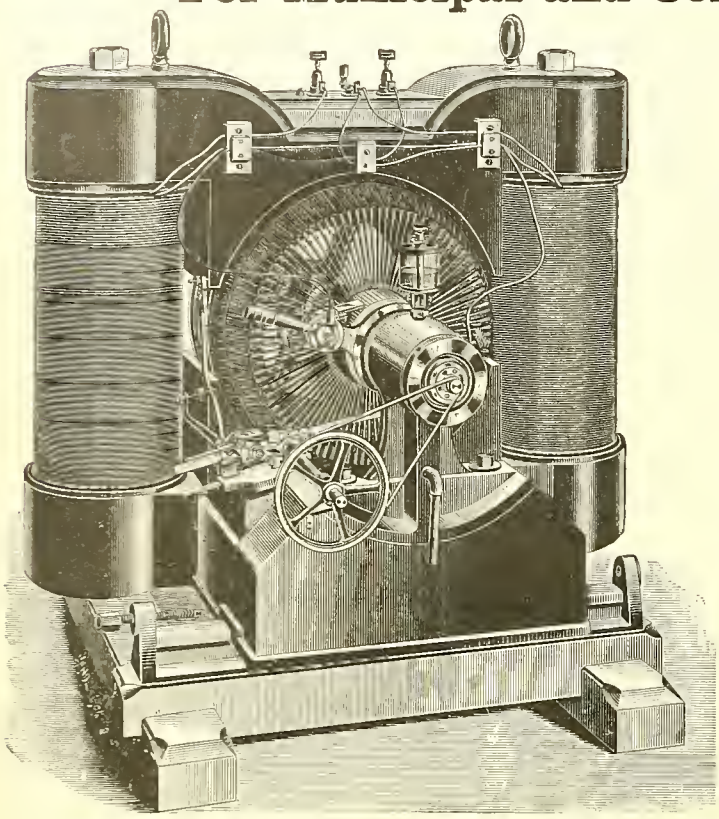

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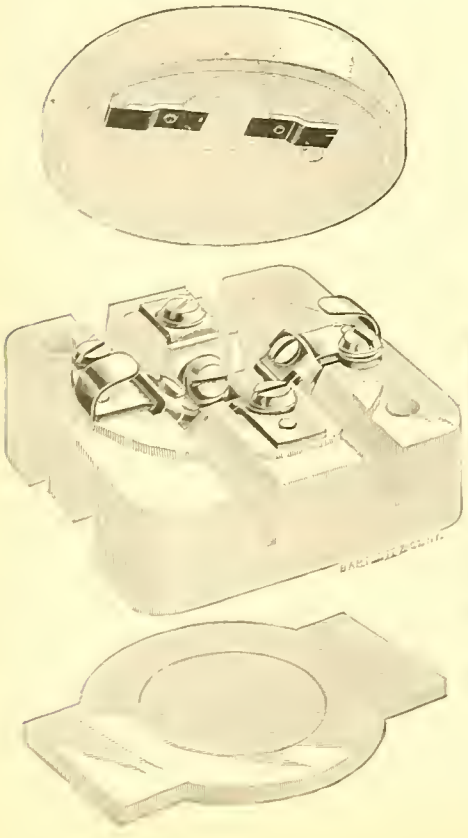

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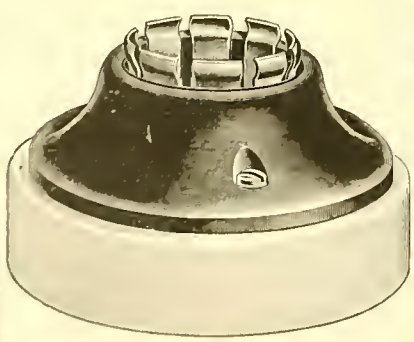

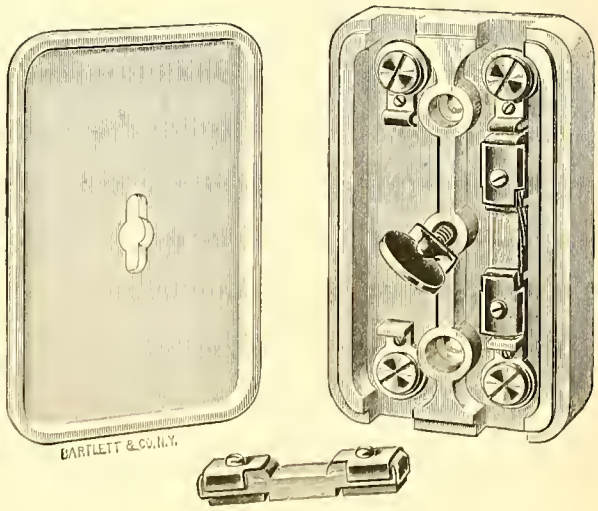

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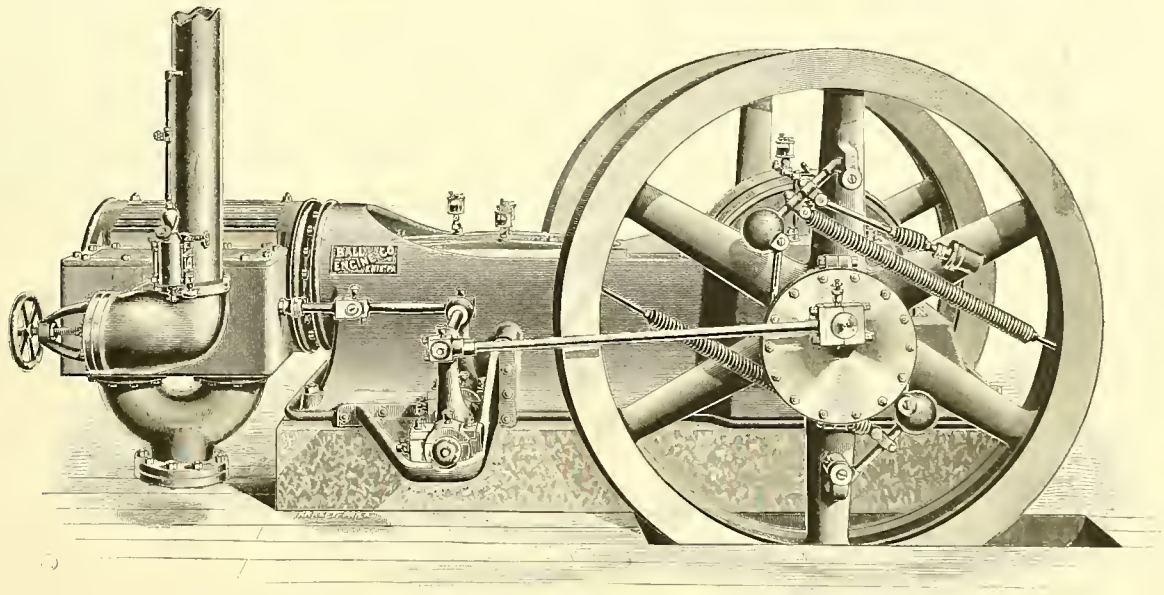

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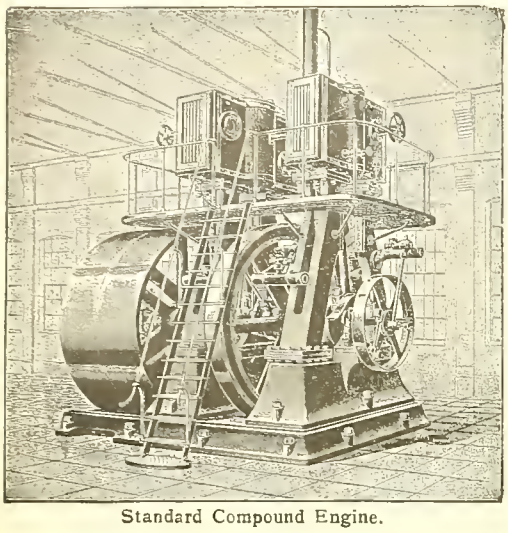

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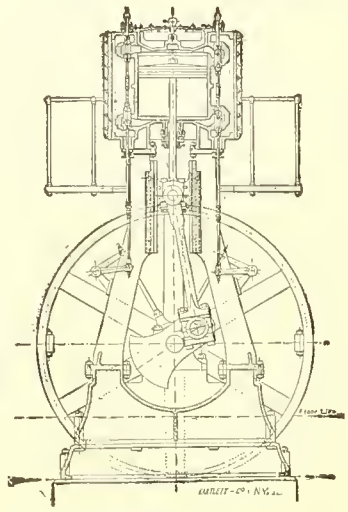

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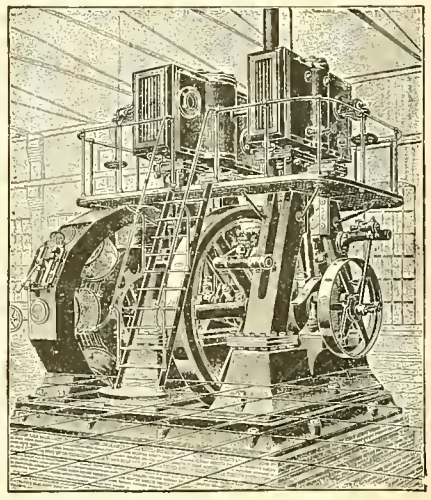

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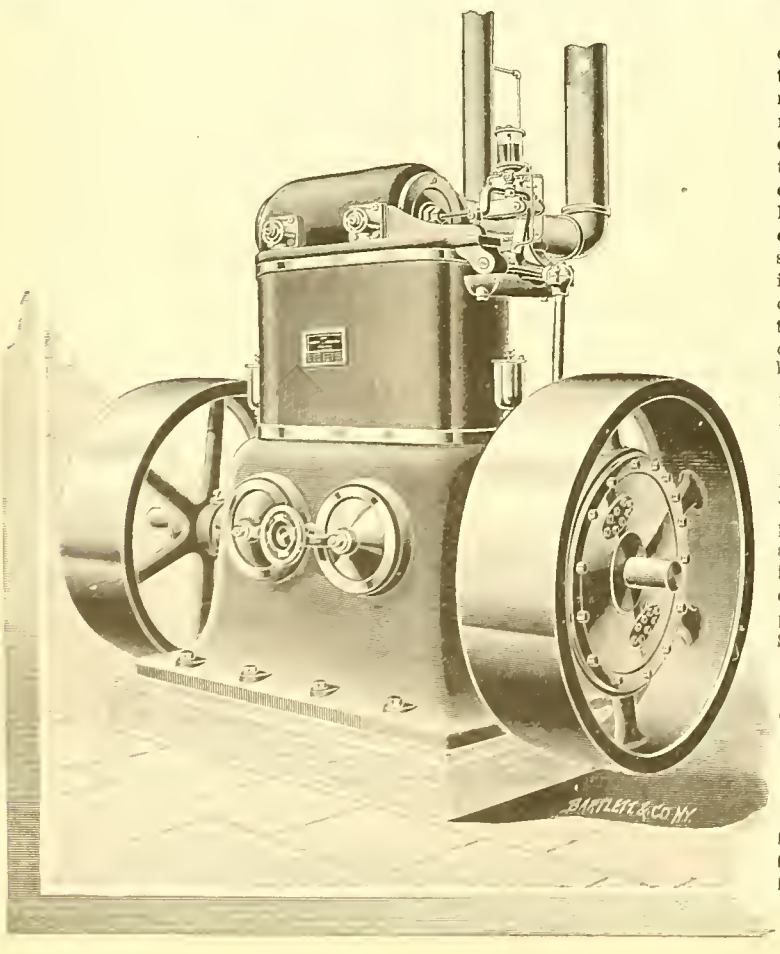

The Compound Engine, when non-condensing, so far from possessing an economy superior to the Simple Engine, has been decisively proven, "much to the disgust of the stockholder," to show normal economy only at or about its rated power, and to fall off in economy faster than a Simple Engine as the load falls off; moreover, very much faster under the extreme light loads that are common in Electrical Generation. This point is at last reluctantly admitted by the more candid builders of such engines, most of whom now advise against compounding for variable loads. The reason is in their inability to divide the load and range of temperature proportionately and automatically between the cylinders at all points of cut-off. Hence, the low-pressure cylinder expands its steam below atmosphere under a moderately early cut-off, thus converting itself into an Air Pump, and becoming a load upon the high-pressure cylinder instead of a co-laborer with it. This point was distinctly foreseen by the designers of the Westinghouse Compound Engine, and an entirely new principle was worked out, making expansion below atmosphere impossible under any load, however light. **For the first time in the history of Steam Engineering, either Simple or Compound, is built an Engine which maintains essentially uniform economy, irrespective of load,** and hence for the first time the Compound Non-condensing Engine has been made practicable. The results, demonstrated by test, show that where an ordinary Compound will range from 25 lbs. to 70 lbs. water per H. P. per hour from full to quarter load, the Westinghouse Compound, between the same limits, will range from 23 lbs. to 29 lbs. We have not deceived ourselves in this matter, and propose that the facts shall be understood. To those interested in the nicer points involved, we will be pleased to send a reprint of the paper read by Mr. F. M. Rites on this subject at the late meeting of the American Society of Mechanical Engineers, at San Francisco.

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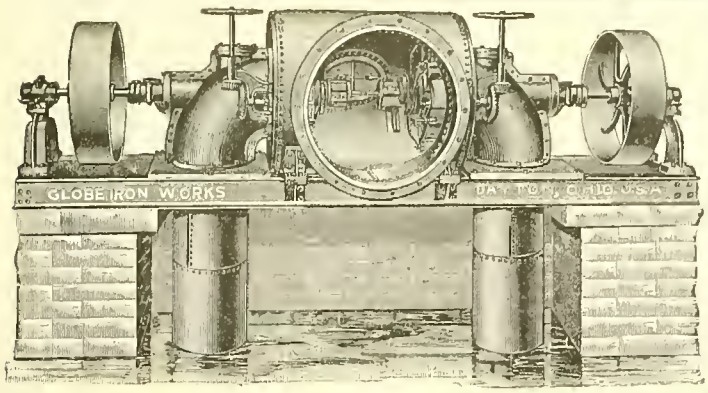

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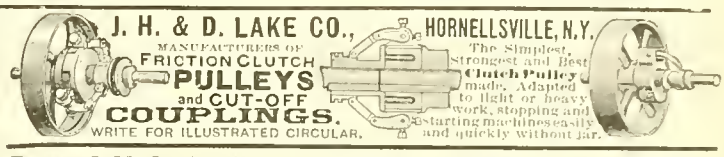

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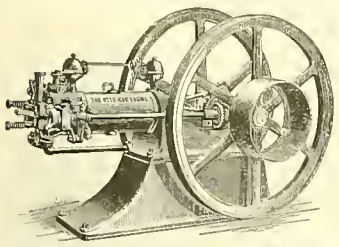

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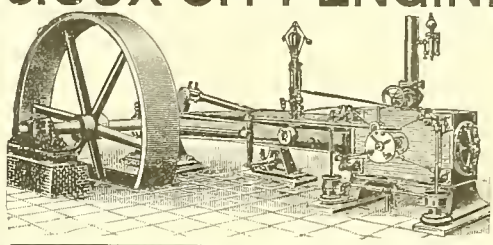

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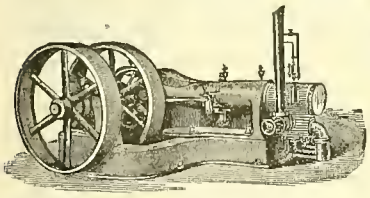

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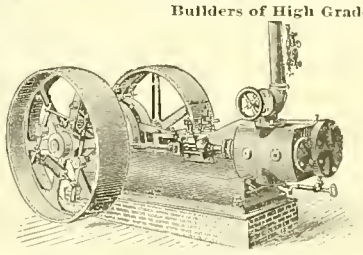

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Fuel Saving, Smoke Preventing.
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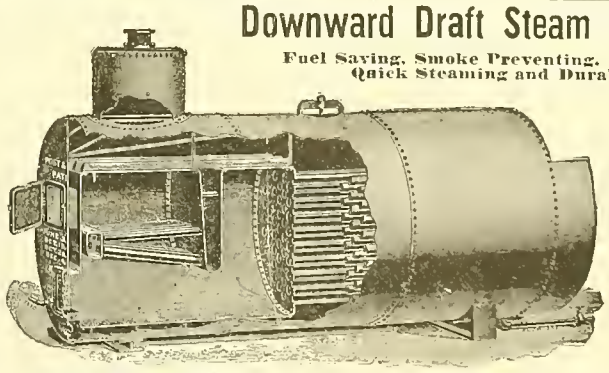

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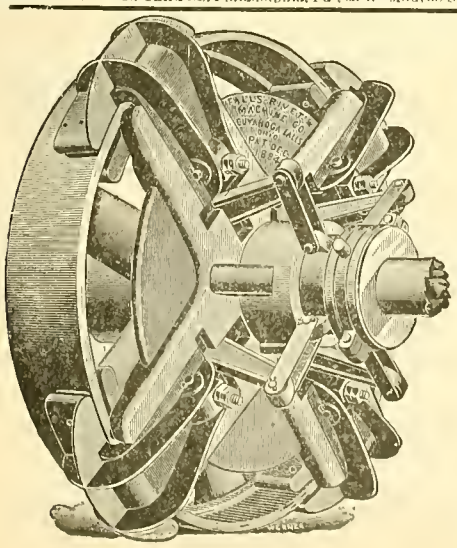

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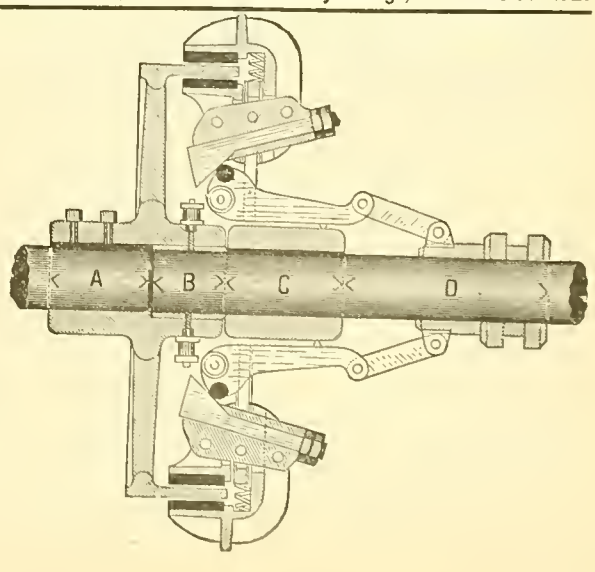

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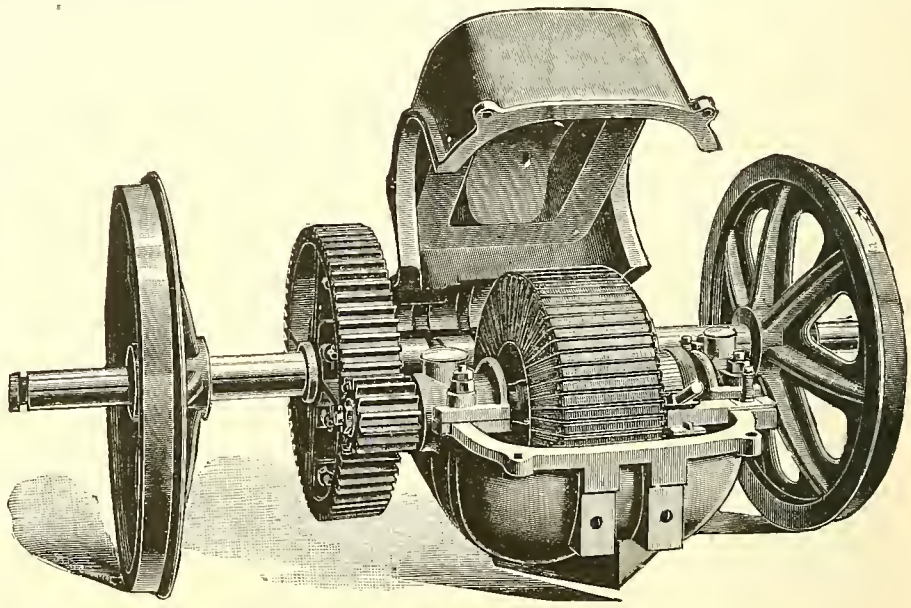
ELECTRIC STREET RAILWAYS.

The W. P. Iron-Clad Motor

Has undergone the most stringent tests possible, and has fulfilled the most rigid requirements of Street Railway Service.



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OUR LINE OF OVERHEAD PARTS AND RAILROAD SUPPLIES

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Should be Ordered from us at Once.

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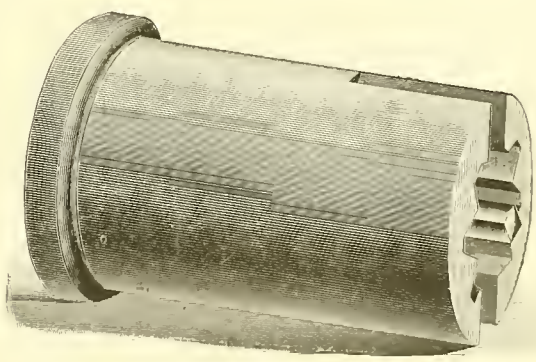
Chicago Carbon Battery,

The Best Open Circuit Battery Made

The leading features of this battery are: A jar with shoulder projecting inward, on the paraffined surface of which the paraffined shoulder of the carbon rests.

The zinc supported by a rubber ring, passes through a porcelain insulator in the center of the carbon.

Cell complete, $1.00.
Liberal discount to the trade.



Carbon Element.

It will be seen from the accompanying cut that there is a large carbon surface, and the battery is very quick acting. It will give 2 volts E. M. F. within one minute after being connected up.

We also manufacture this style of carbon for use with a Leclanche jar which enables users of the Leclanche Battery to replace their porous cups with our carbon.

Manufactured By

The Knapp Electrical Works,

54 AND 56 FRANKLIN STREET.

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FUSE WIRE
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FUSE LINKS.

Our reliable Fuse Links are "one piece" and will not get loose under binding screws.

The Stanley Transformers

Are already so well and favorably known that we are at a loss to say anything that will add to the brilliant record which they made for themselves during the past year.

SHIELD BRAND
MOISTURE-PROOF WIRE.

For Feeder Circuits.
For Light and Power Lines.

BILLY WILLIAMS.

A SKETCH.

"Billy" Williams was foreman of the gang. Where he came from nobody knew, and why he was apparently contented to fill that ordinary position, was likewise a mystery. Billy was not a person that one would be likely to ask idle questions of or try to pry into his private affairs. He came in the nick of time to the Consolidated Electric Railway, Light, Power, Heating and Cooking company. They were just looking for some one who could handle the rough men that made up their construction gang. Two had tried and given it up. Billy wasn't big and brawny, but he had a determined snap and sparkle in his eyes, and certain quick, alert movements that carried conviction with them. The "bully" of the gang had tested his temper the second day and met with instant and complete disaster. The others looked on for a moment, undecided whether to side with Bub Jackson or the foreman, but as Bub picked himself up and started for Billy the second time, only to be knocked into insensibility, they quickly concluded that they had found their master. No one was more positive of this than Bub Jackson himself, and he became an ardent admirer and excellent assistant to the new "boss." But Billy had a tender spot, and that was his home. His little wife Claire evidently understood him perfectly and was in full accord with his motive in serving in his present capacity. If he was severe and determined with his men, he was tender and loving to Claire and the baby.

This night they had finished supper and he had settled himself for a quiet evening. It was early in the spring of '91, and outside a bitter, nasty storm was driving. Rain and sleet poured down together, and as the doors and windows rattled with the gale the little cozy sitting-room seemed very inviting to the tired man. He toasted his slippered feet before the open grate (we intended to work in an electric heater in this act, but the stage manager swore it would knock all the poetry out of the scene, and we reluctantly told the property man to rig up a gas log and lug in a bucket of bogus coal) and watched the tongues of fire chase their curling wreaths of smoke up the chimney.

A copy of the evening paper, *The Boomtown Echo*, had fallen from his hands. Claire sat across the table, busy with some little frocks. A drowsy languor closed his eyes. Claire's contented humming became a far-off song that lulled him into deeper sleep. Their house was in communication with the station by telephone. Claire had just looked up to see what time it was. It was eight, and the clock had barely struck the hour when the telephone startled her. Bling! ling, ling, ling! Billy sat up straight with a suddenness that nearly upset the table.

Claire answered the call.

"Hello? Hello?"

"Yes, this is 257."

"Yes, he's here."

"Well, tell him to come down quick," came from the other end. "The Main street circuit has—"

"Hello! what's that? the 'street circus'—"

"No—Main street c-i-r-c-u-i-t, circuit—"

"Oh, yes, all right, 'circuit.'"

"Has gone dead; come quick."

Billy was used to frequent extra calls of late, but it was no pleasure to face the storm that was flooding the streets to-night, and turning the gutters into miniature rivers.

As he buttoned up his great coat Claire brought his hat and mackintosh. He pulled on his gloves and overshoes.

"Be careful, dear," said Claire as he opened the door to the hall.

"It's too bad, isn't it? I wonder what's the matter."

Catching an up-town electric he was soon at the station.

Bub Jackson had gone back after supper to grind his climbers, and while waiting for Billy had sent for two or three of the men, and they had located the trouble, or thought they had.

"What is it, Bub?"

"The river's up considerable, and there's a big cave-in down along the bluff, Billy. If it's as bad as it looks I think we've got about fifteen poles on 'number two' float in' down to Dixie, and takin' the wire along with 'em."

"Number two" was the heaviest and most important lighting circuit. A Westinghouse alternator sent its current over the line in rapid beats to hundreds of Stanley transformers. On this circuit was the opera house, the new city hall, and many of the largest retail stores. The station telephone was ringing incessantly with complaints, "We're in the dark; what's the matter?" Very few had any gas pipes in, as they were enthusiastic over the electric lights, and vied with each other in making a brilliant display.

There was no time to be lost, and Billy gave a few rapid orders.

"Here, Sam! unlock the storeroom and roll out that big reel of Shield Brand."

"Get the 'widow,' Bub." The "widow," as they called it, was a two-wheeled arrangement for carrying a reel. It was a suggestion of Tim Carty's. "Got any lanterns, Tim?" Tim had four lit in a moment, and in the mean time the reel of wire was swinging between two wheels, ready to roll.

Pushing it into the street, they started towards the bluffs on a trot. The rain was coming down in sheets. Fifteen minutes hard running and stumbling and splashing through puddles brought them to the beginning of the cave-in. The river swept around the bend with a strong current, that had cut over the rip-rap, undermining the high bluff until it toppled in, carrying with it about half a mile of poles and lines. The river was full of floating cakes of ice, and the wires had parted under the unusual strain. Stopping at the first pole that seemed secure for the night, they pulled in a stretch of wire and quickly spliced on to the reel.

A macadamized road ran parallel with the river and about one hundred feet back from the bluff.

It had been opened since the poles were set up.

"Make for the road," shouted Billy. Tim Carty, and Bub Jackson pulled the cart up a muddy incline until they struck the road. Billy followed, letting the wire pay out through his hand. Sam Peters ran ahead with two lanterns. For a little over quarter of a mile they kept to the road, floundering at one place in a small wash-out and breaking a lantern. Billy judged that they were about opposite the lower end of the "cave-in" by this time, and pushed through a thicket to reconnoiter—he stumbled over a fallen pole. By hard tugging they jammed the cart through the brush. As the wires were cut, going into the river, they whipped away with a twang that meant they must have had two or three poles in tow. The splice was soon made to both sides, it only remaining for them to retrace their way back to the first break and connect the second wire.

This was accomplished without accident. The two sides of the circuit must have crossed and recrossed a dozen times in the road, but it mattered little to Billy.

"It will hold out 'till daylight, anyhow," he said.

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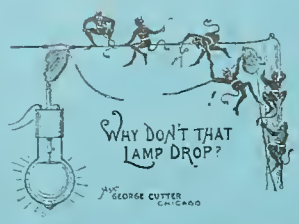

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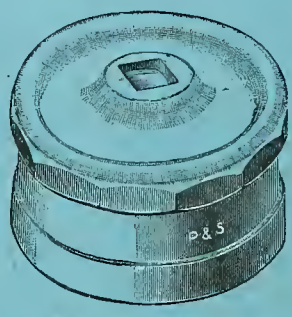

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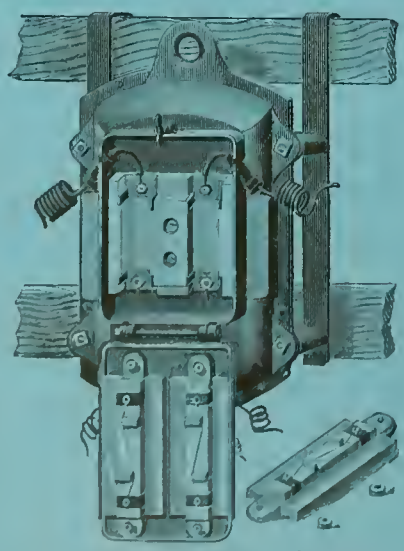

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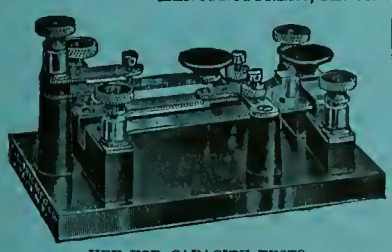

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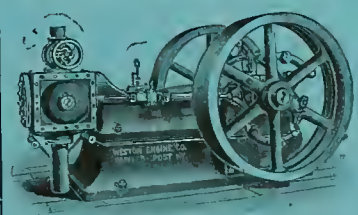

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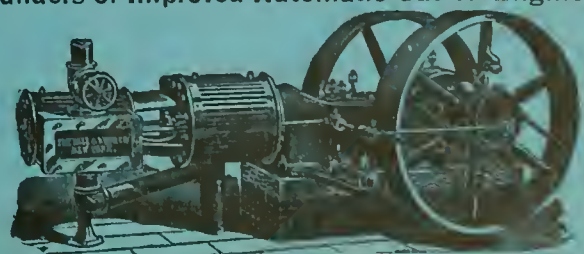

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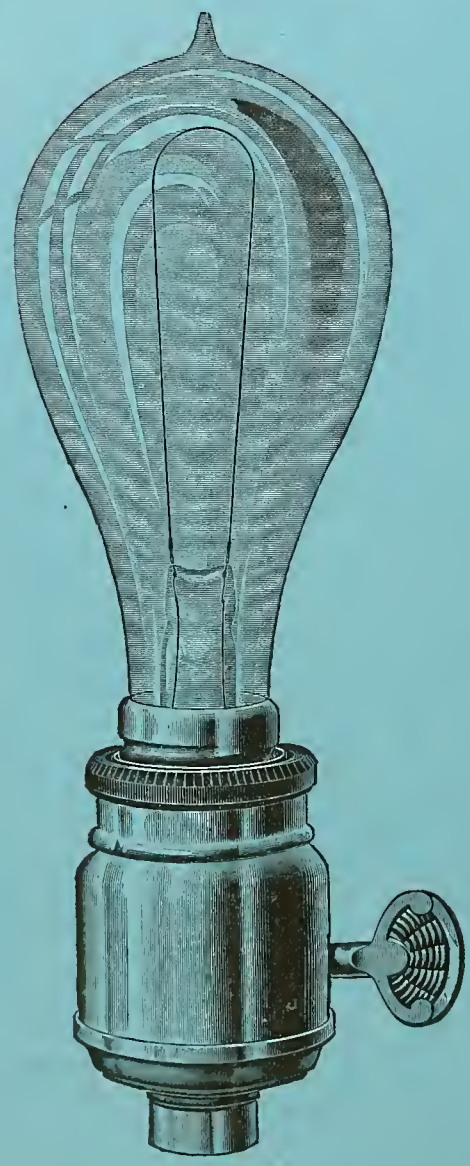

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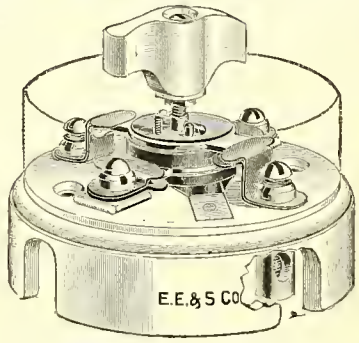

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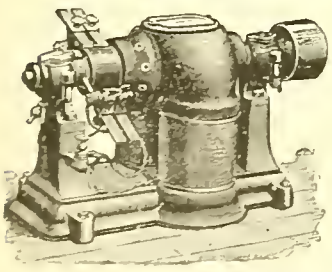

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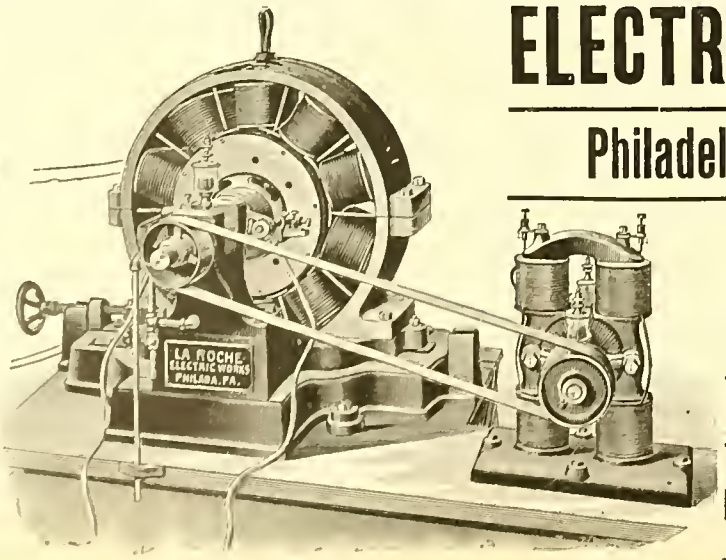

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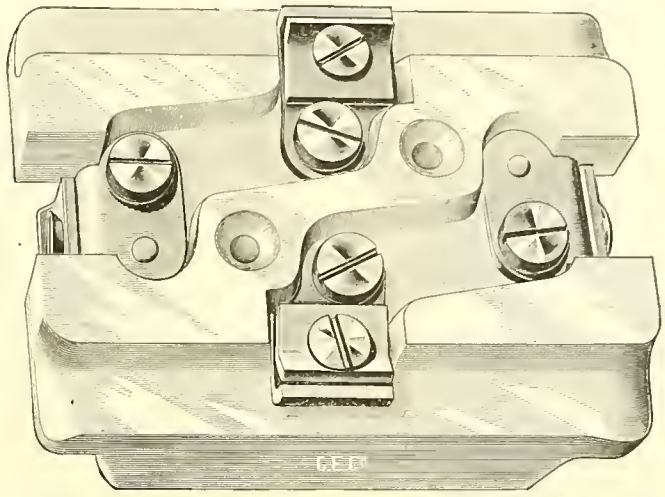

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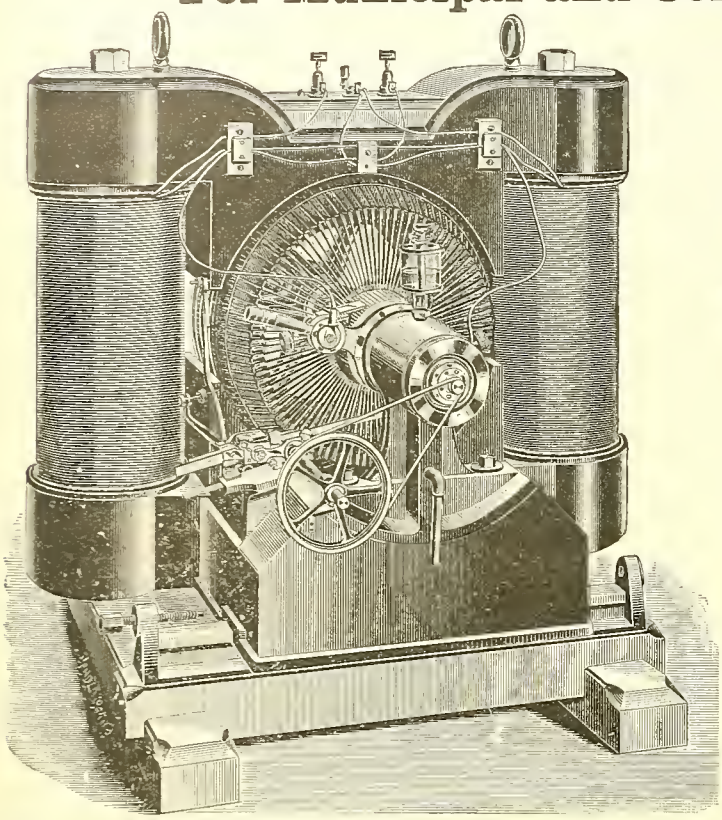

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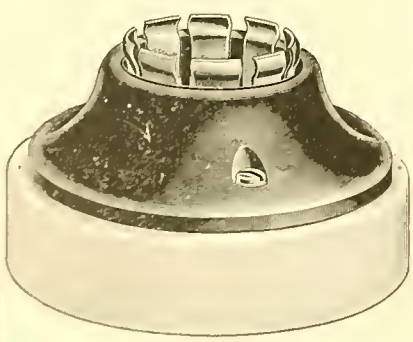

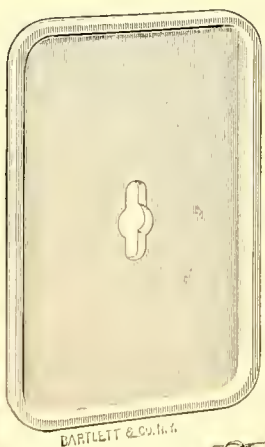

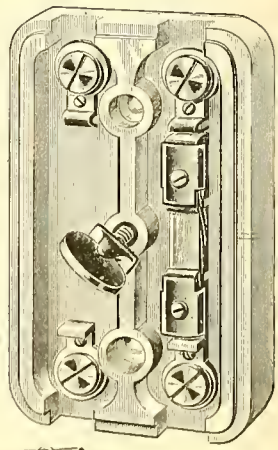

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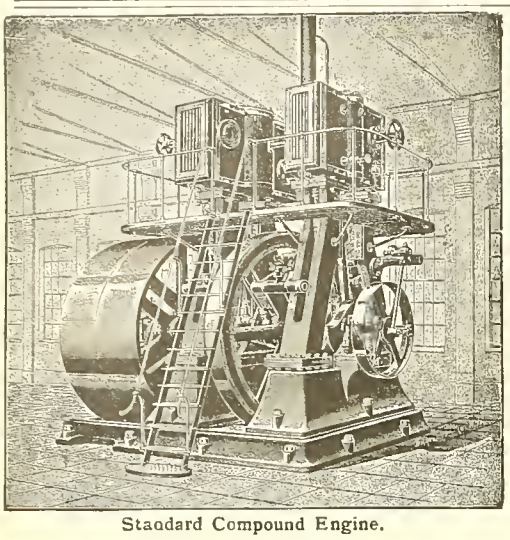

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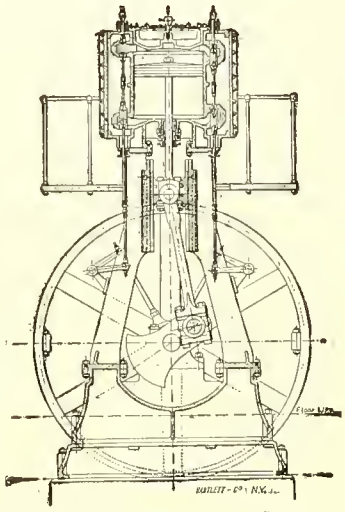

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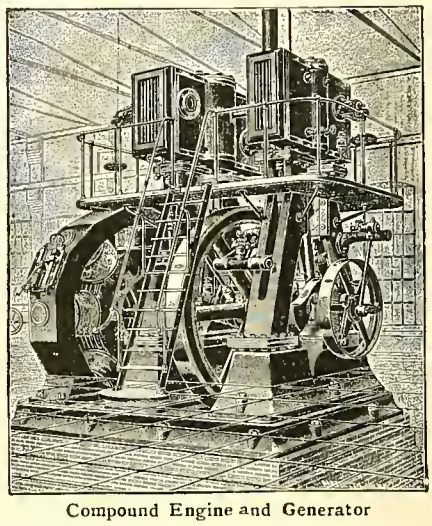

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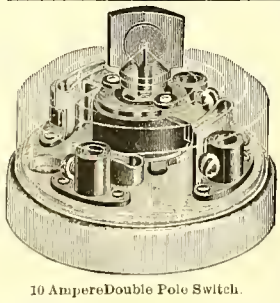

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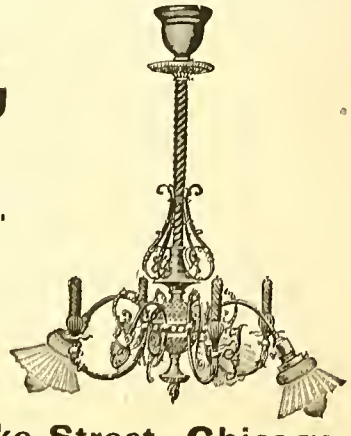

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The poverty of the owners of this property, being land poor, is the reason of this unusual offer, and they will retain as much of the property as they possibly can, parting with only what is necessary in order to work it.

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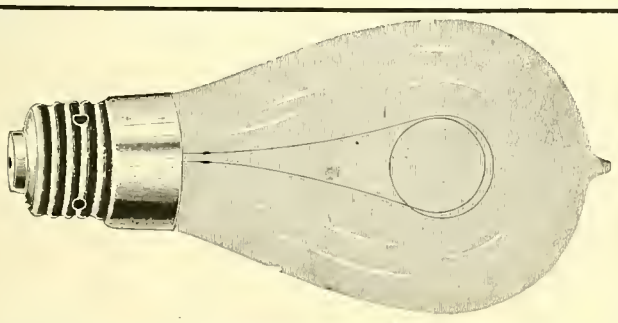

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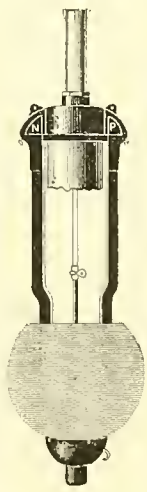

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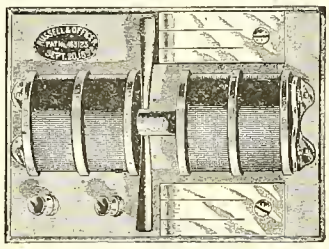

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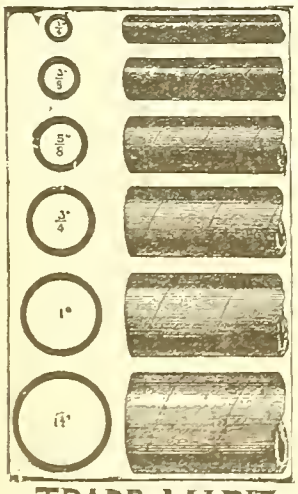

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Third. Special sockets of neat design will be employed for these lamps, and special fittings will be supplied at five cents each, which will adapt any of the forms of sockets now in use to receive the new lamps, thereby bringing about exact uniformity in lamp bases.

Fourth. By reason of the manufacture of the lamps by special machinery and improved methods, by the use of nitrogen for preserving the carbons, and by means of pumping and charging apparatus recently perfected, **WE HAVE BEEN ABLE TO SO REDUCE THE COST OF MANUFACTURE AS TO FIX OUR PRICES FOR 8, 10 and 16 CANDLE POWER LAMPS AT 30 CENTS EACH, SUBJECT TO A DISCOUNT OF 10 PER CENT. TO OUR CENTRAL STATION CUSTOMERS,** and to others from 2½ per cent. upward, according to quantity, **WITH AN ALLOWANCE OF 10 CENTS FOR EVERY BURNED-OUT LAMP RETURNED UNBROKEN** to any one of our factories, making the net cost **OF RENEWALS FOR THE 8, 10 and 16 CANDLE POWER LAMPS 17 CENTS** to our central station customers. For 20 and 25 candle power lamps the prices will be 35 cents each, subject to the same discount and allowance for burned out lamps.

By long and careful tests, and by the use of a large number of these lamps in our works, we have demonstrated that the new lamp will have greater advantages for users than the Edison lamp or any of those heretofore upon the market.

The importance of the improvements in manufacture by which we have been enabled to offer these lamps at so low a price will be appreciated by all users who are aware of the constant deterioration in the carbon burners, and of the fact that the real commercial efficiency of a lamp is its average efficiency. With a constant amount of electric current the ordinary 16 candle power lamps rapidly fall below 10 candle power from deterioration of the carbon, when they must be renewed; and it results from this, that the users, with cheaper lamps will get from 15 to 20 per cent. more light from a given expenditure of electricity by a more frequent renewal of lamps than is now customary. Thus the low cost of the lamps may be made to add to the revenue of a lighting station in one of two ways, viz., either by giving a greater lighting capacity at the present cost of lamp renewals, or by actual saving in the cost of lamps with renewals made at the present period of renewal.

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We are also contemplating the erection, as the business develops, of "renewal stations" in all large cities such as New York, Boston, Philadelphia, Chicago, Cincinnati and St. Louis, thereby reducing the cost of shipment and return of lamps for renewals, and still further reducing the net cost of the lamps to our customers.

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(Signed) HARVEY TRANSIT COMPANY, By P. L. Wells, Electrician.

METROPOLIS, ILL., Jan, 10, 1893.

GENTLEMEN:—In reply to your inquiry in reference to the Elkhart Converter, we have to say that they are the easiest erected and give the best satisfaction of any that we have used.

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(Signed) Thos. L. Davis, Supt., City of Metropolis Electric Lt. Plant.

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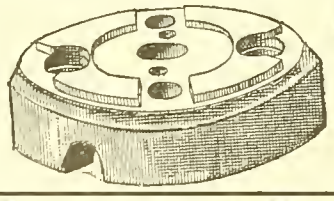

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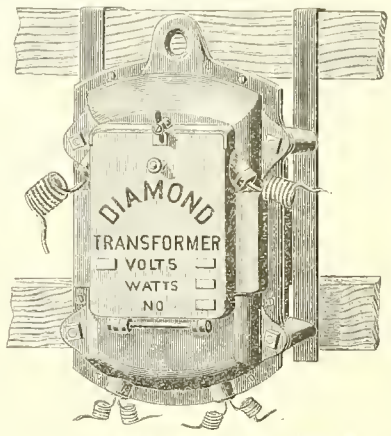

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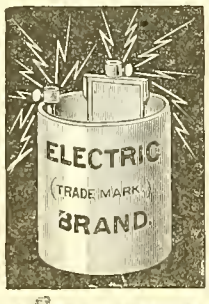

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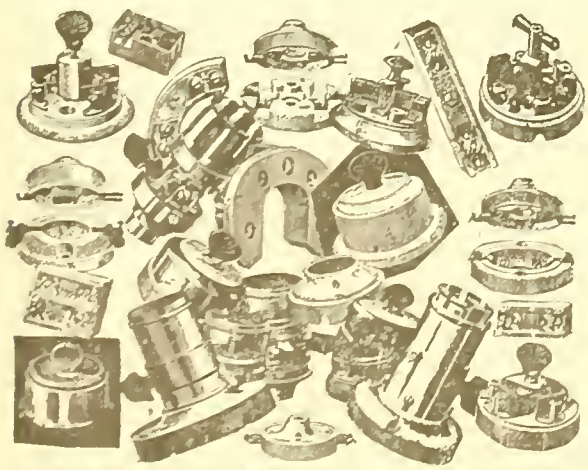

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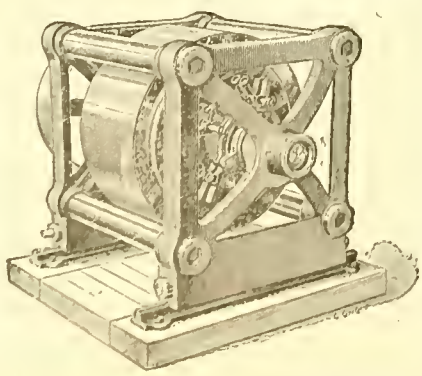

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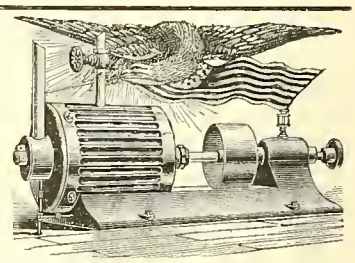

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Western Electrician

EVERY SATURDAY.

Vol. XII. CHICAGO, JANUARY 28, 1893. No. 4

Electricity at the World's Fair.

At last the WESTERN ELECTRICIAN is enabled to give a view of the southern pavilion of the electricity building, showing the elaborately decorated hemicycle, although it is impossible to reproduce the vivid coloring used by the decorators. This semi-circular space will contain the statue of Franklin and may be considered the principal entrance to the building. In a description of the structure written for this journal by the architects, Van Brunt & Howe of Kansas City, nearly two years ago, this paragraph occurs:

The south pavilion is a hemicycle or niche, 78 feet in diameter and 103 feet high. This niche is covered by a half dome with ribs and decorations in relief, the Corinthian order being carried around the walls of the niche. The opening of this niche is framed by a semi-circular arch, the impost of which is supported by four full Corinthian columns continuous with the order of the facades. This arch is crowned by a gable or pediment with smaller gables on the returns, and surmounted by an attic, the whole reaching the height of 142 feet. In the center of this niche, upon a lofty pedestal, is a colossal statue of Franklin, whose illustrious name intimately connects the early history of the republic with one of the most important discoveries made in the phenomena of electricity. In order to carry out this idea, on the frieze of the great order around the niche appears the Latin inscription, "Eripuit cælo fulmen sceptrumque tyrannis."

The view of the lower portion of the hemicyle, Fig. 1, is somewhat impeded by the snow on the ground and several freight cars. The latter serve to give an excellent comparison of distances, however. In Fig. 2 is given a glimpse of the eastern facade of the building, facing the lagoon separating it from the manufactures building, showing the Corinthian columns and profuse ornamentation.

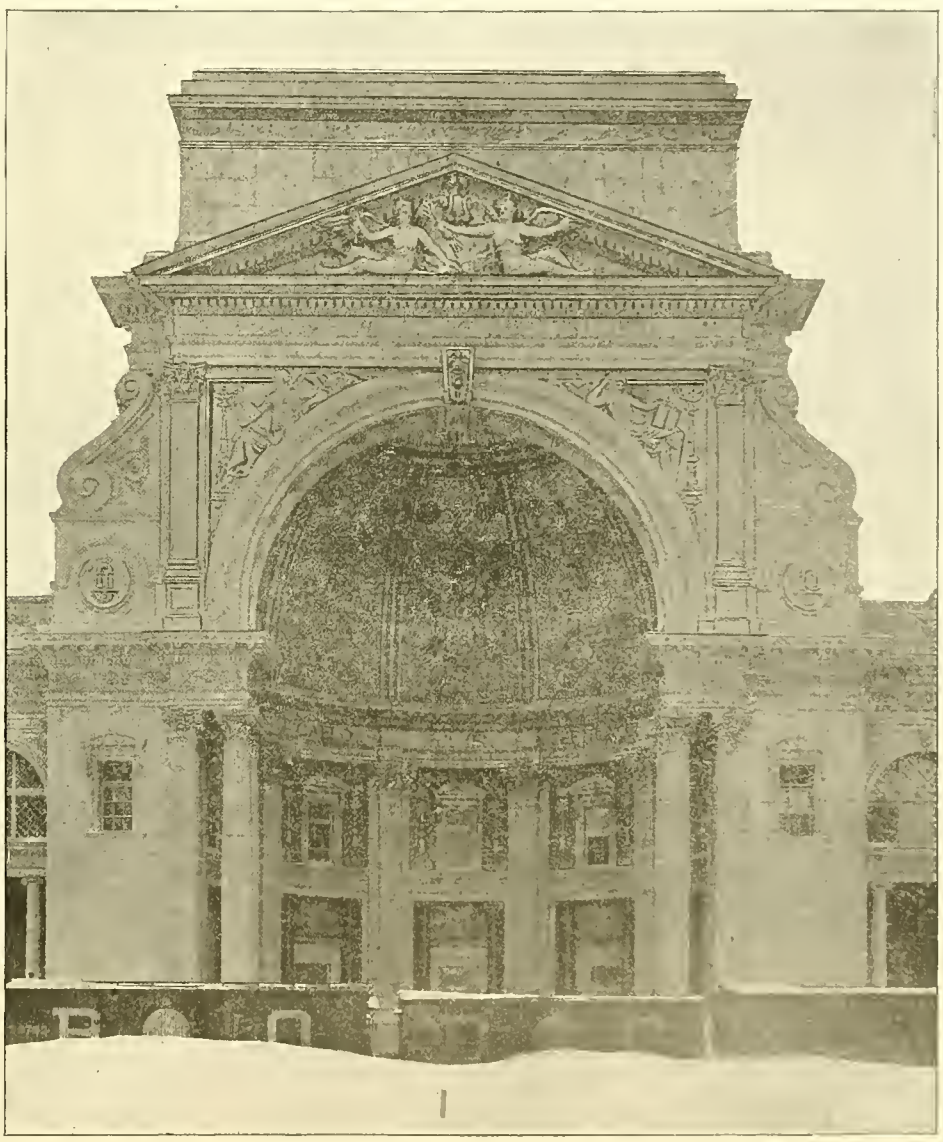


FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.

Chief Barrett has appointed Willis Hawley electrical engineer to the department of electricity. Mr. Hawley has recently had charge of a central station in Urbana, O., and was formerly with the Western Electric company. He entered upon the discharge of his new duties last week.

The Westinghouse office building, south of machinery hall, is now enclosed, and will be ready for occupancy in a few weeks.

The Morgan Engineering company's electric traveling crane in machinery hall is now in operation. This crane is in the northern row of arches and is made conspicuous by white paint and bold lettering. It is of 20 tons' capacity and is operated by seven Thomson-Houston iron-clad motors.

Two of the large dynamos which are intended for the incandescent lighting plant at the World's Fair were placed in exhibition at the works of the Westinghouse company in Allegheny last week, and were shown in operation together with the new Westinghouse lamp. These dynamos were illustrated and described in the WESTERN ELECTRICIAN October 8, 1892, and the lamp was illustrated exclusively in this journal October 22, 1892. The exhibition last week was the first opportunity afforded the public of examining the apparatus the company will use in lighting the fair buildings.

Those who are familiar with the ins and outs of the discussion in relation to the electric fountains at the World's Fair will sympathize with Mr. Stieringer, the designer, in his indignation over the ridiculous botch that appeared in the *Electrical World* of last week as the result of an attempt to describe this feature of the exposition. Referring to this subject in a letter sent to the WESTERN ELECTRICIAN Mr. Stieringer says:

Reliable news regarding the progress of the plans for the World's Columbian Exposition is now of much importance to many electrical readers. The attempt of the *Electrical World* of this week to show in advance of the proper time of publication features which have not yet been decided upon regarding the proposed illuminated fountains recalls a similar effort by the same paper less than three years ago. At that time I sent to the *Electrical World* for publication the following letter, which never appeared in its columns:

I am greatly interested in the sketch in your issue of this week of the "Proposed Edison Light Tower at the Minneapolis Exposition," more especially because, having the responsibility of designing and erecting this tower, I am still undecided as to nearly all the detail which your sketch purports to illustrate. I congratulate you upon the vividness of the imagination of your artist, and only regret that his idea and my own should have happened to be entirely dissimilar, and that his picture of this feature of the coming exposition fails entirely to give your readers an adequate conception of the magnitude and beauty of the proposed structure and its surroundings.

Both these unreliable batches of information came from the same source, the artist whose name appears on the illustrations. In the case of the Minneapolis tower the disclosure was simply imaginative and premature; in the present case of the Chicago fountains it is both imaginative and inaccurate, and also a breach of faith. I presume it will be characterized as "newspaper enterprise"—the sort of enterprise that, when it cannot print a genuine interview, prints an imaginary one.

I believe it was the celebrated A. Ward who once said: "I had rather no nothing at all than to no what ain't so."

World's Electrical Congress.

The advisory council of the World's Electrical Congress met Thursday, January 17th, at the American Institute of Electrical Engineers, New York. Prof. Elisha Gray presided, and Herbert Laws Webb acted as secretary in the absence of Prof. Carhart. The following named gentlemen were also in attendance: Prof. William A. Anthony, Prof. Charles R. Cross, Dr. Louis Duncan, Dr. William Geyer, Carl Hering, George A. Hamilton, Prof. F. B. Crocker, A. E. Kennelly, T. D. Lockwood, T. C. Martin, George M. Phelps, Dr. M. I. Pupin, R. W. Pope, Prof. H. A. Rowland.

It was decided that the World's Electrical Congress should begin August 21st and last one week.

It was also decided that the congress should consist of two chambers, of which the legislative chamber shall decide on units, names of units, and standards, and shall be composed entirely of delegates named by their respective governments. The following apportionment of delegates was made: Great Britain, France, Germany, Austro-Hungary, United States, 5 each; Belgium, Italy, Switzerland, 3 each; Holland, Denmark, Norway and Sweden, Russia, Spain, 2 each; Portugal, British North America, Australian Colonies, India, Japan, China, Mexico, Brazil, Chili, Peru, Argentine Republic, 1 each; making a total of 55 official delegates.

The chairman was authorized to appoint committees on papers and programme, invitations, finance and an executive committee.

The committee on papers and programme shall consist of eight members whose duty it shall be to invite, receive and consider papers and other documents relating to the work to be brought before the congress and to formulate

a programme. The preliminary reports of the American and English committees were referred to this committee.

The committee on invitations is to consist of five members, who shall select and recommend to the chairman the names of electricians, electrical engineers and others who shall be members of the congress. The committee will co-operate with the foreign committees. In addition to invitations to deliberating and voting members of the congress it was decided to extend a general invitation through the electrical journals to the public, to attend the meetings.

The executive committee will be composed of five members, and will have full power to act for the advisory council. The question of charging a fee for membership

FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.

of the congress and fixing the amount was referred to this committee.

The finance committee will contain three members and like the other committees will be appointed by the chairman.

Novel Trolley Arrangement.

The new overhead trolley electric railway in South Staffordshire, England, is distinguished by a new trolley arrangement, shown in the accompanying cuts, which are reproduced from London *Industries*. The trolley wires and feeders are carried on neat iron poles, which are light, strong and flexible. Iron arms are attached to carry the wires. The feeders are bitumen insulated and lead sheathed, and armored with steel tape, and thetrolley wires are bare copper .31 inches in diameter. The trolley rod arrangement is peculiar. As will be seen from Figs. 1, 2 and 3, it projects from the side of the top of the car, and is swiveled, so that by altering its horizontal angle with the car it can adapt itself to varying distances between the trolley wire and the rails. The object of this arrangement is to obviate the necessity of having the trolley wire directly over the center of the track, and to allow it to make fairly sharp angles where the tracks sweep around curves. By this means the necessity for a complicated system of "frogs" and "pull-overs" to make the trolley wire follow the exact curves of the track is avoided. This is a great improvement, says our English contemporary, provided that it will work well in practice after continued use. Trolleys always evince a strong inclination to jump off the wire, and this tendency will be by no means lessened by running them with an oblique pull. The details of the trolley are shown in Figs. 1 and 2. It will be seen that the groove is like that of a rope pulley, and there is an oil vessel below, with a wick for keeping the wheel thoroughly lubricated. The cars are of the two-decker type, and are 22 feet long, weighing about six tons, with motor mechanism complete. Single reduction gear is used, the power varying up to about 30 horse power.

The electric street railway company and the electric lighting company of Ithaca, N. Y., have sold their stock to a syndicate from Scranton, Pa. The capital stock of the old street railway company, $45,000, has been increased to $175,000. The lighting company's stock will remain at $50,000. The two corporations are to be continued with the same officers and directors in both.

The Thomson Recording Watt Meter.[1]

By Parmalee J. McFadden.

In this paper on the Thomson recording watt meter I will endeavor to give briefly a description of its physical characteristics, and the electrical principles underlying its design, and will avoid any discussion of its abstract mathematical equations, as my instructions from your literary committee were to prepare a paper that would not take long in its reading, and yet would give those of you who are not familiar with the meter a clear idea of its construction and application in commercial practice.

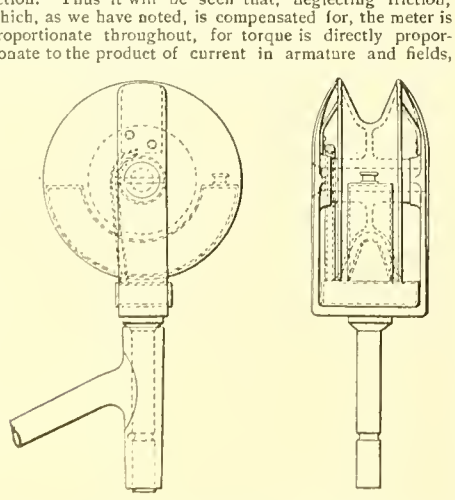
In designing this meter several essentials had to be strictly observed: First, the meter must be theoretically correct in principle; second, it must be of the simplest possible construction; third, it must be easy to install and to maintain in operation; fourth, it must be accurate throughout its range; fifth, it must be automatic. In addition to these requisites it was the aim of the inventor that the meter should operate with equal facility and accuracy on circuits of either direct or alternating currents, and it was his opinion that such a meter should be a motor meter; that is to say that it should be actuated by the same energy which it measured, avoiding, for instance, the necessity, as in clock meters, of winding up the mechanism at stated intervals.

Briefly, then, this meter consists merely of a simple skeleton motor, having no iron either in armature or field. The fields, which consist of two coils, one on either side of the armature, are connected in series with the lamps or motor, whose absorption of energy they are to measure, all the current in use passing through these field coils. The armature, which is of the Siemens drum type, is hollow, and is made of a fibre cylinder, over which the coils are wound. On the end of the shaft of the armature is a silver commutator, on which rest flexible bronze brushes, provided with silver contact pieces. The armature is shunted across the circuit in the manner of a lamp, and to cut down its current a high resistance of fine wire is connected in series with it, the whole forming a pressure coil whose current varies with the voltage of the system.

It will readily be seen, therefore, that as the field varies with the current, and the armature with the pressure, the speed of the motor will vary directly with the energy or watts in use, which is of course the ideal method of measurement.

Friction would, however, seriously affect the accuracy of those results were it not compensated for. This is accomplished by taking off the armature circuit beyond the fields. Thus there is a slight constant field, independent of that created by the current flowing to the lamps, caused by the flow of the armature current through the field coils. On very low loads, where friction is a strong factor, this "shunt" or constant field forms a comparatively considerable percentage of the total field and torque, thus nicely balancing the meter against friction, whilst on medium and high loads both friction and the shunt field become so insignificant a percentage of the total load and torque that their influence cannot be detected and may be neglected.

Another essential feature of the meter deserves description; namely, the slowing mechanism or means for loading the meter. The necessity for this retarding mechanism is too apparent to need explanation, and has been fully appreciated by all makers of recording motor meters. In the Thomson meter this is accomplished in the most simple and satisfactory manner by placing on the shaft a thin disk of copper, some little distance below the armature. This disk rotates between the poles of three permanent magnets. The fields of these magnets generate Foucault or eddy currents in the disk, thus forming a considerable drag or load on the motor, which is constant and proportionate in its action. Thus it will be seen that, neglecting friction, which, as we have noted, is compensated for, the meter is proportionate throughout, for torque is directly proportionate to the product of current in armature and fields,



FIGS. 1 AND 2. NOVEL TROLLEY ARRANGEMENT.

which equals amperes x volts—that is, torque is directly proportionate to power or watts passing the meter. Speed is directly proportionate to torque, and the retarding effect or generation of current in the disk is directly proportionate to the speed. Therefore, the theory of the instrument is consistent and correct throughout.

Another good feature of the meter is that the drag or load is considerable, hence friction, which is the only varying quantity, forms, even on light loads, but a small proportion of total retarding effect.

The indications of the meter are shown in watt hours on the dial, the first wheel of whose train engages with a worm on the shaft, thus connecting it with the revolutions of the armature. The five dials of the whole train will record up to 10,000,000 watt hours, that is to say, approximately 200,000 lamp hours, and it is only then that the dials all come back to zero. This for the smaller sized meters without constants. The largest sizes will register as high as 360 million watt hours before reaching zero again.

1. Read before the Chicago Electric Club, January 16, 1893.

By an examination of the dial it will at once be apparent that the friction absorbed in actuating the recording mechanism is so small as to be negligible, as the power required is so slight that it is scarcely possible to move with the finger the first gear, which engages with the worm on the shaft so slowly as not to see the first dial hand move, and yet when the meter is running at full load this motion of the dial hand is not discernible. Here then is one of the two possible chances for friction, reduced to practically zero.

It is essential that a motor meter have a slow rate of revolution so that no possible resistance can be introduced by reason of friction of the gears of the train or on the lower and only bearing. To accomplish this and still to use the same recording mechanism on all meters, the larger size meters are made of such electrical dimensions that their rate of revolution will be 1 2, 1-3, 1 6, etc., slower than their normal, thus keeping the revolution of all

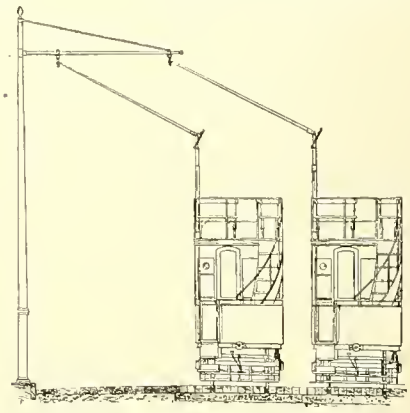


FIG. 3. NOVEL TROLLEY ARRANGEMENT.

meters down to about sixty revolutions per minute at full load, and consequently lengthening the life of the meter. In such cases the corresponding constants of 2, 3, 6, etc., are marked on the dial by which the readings are to be multiplied. These constants are uniform throughout any given sized meter.

The only other point in which friction might appear is at the bearing on which the lower end of the vertical armature shaft rests. This, again, is reduced practically to zero by having the shaft's point hardened, very carefully ground, and highly polished, and in having the bearing made of sapphire. This jewel is inserted in the end of a brass screw which passes through the bed plate of the meter.

If the jewel should, by reason of a continual vibrating or pounding of the shaft upon it, become cracked, the point of the shaft would become worn and the meter run slow. To prevent the occurrence of this, the jewel setting is mounted on a small spiral spring contained in the hollow screw, and this permits of the bearings following every motion of the shaft and presents no rigid surface upon which the vibrating shaft can deliver a sufficient blow to do any damage. The calibration of the meter is readily and effectively accomplished by moving the poles of the permanent magnets toward or away from the periphery or center of the disk, thus increasing or decreasing its speed until it becomes synchronous with the standard instrument.

We have seen by the description just given that the theory of the Thomson recording watt-meter is necessarily mathematically correct, save for that slight error, which is induced by friction on the lower loads. We have also seen that this error is reduced to an almost negligible quantity by connecting the armature into the circuit in such a manner that the current passing to the armature passes first through the field coils, thus giving a certain initial torque which is present at all times, and which on low loads forms a considerable portion of the total torque; this initial torque being so proportioned as to almost absolutely balance friction, the meter being in fact poised when entirely free from loads.

It may have occurred to some that as the size of the meter increases, so would the number of turns in the field decrease, and therefore a meter of 100 lights capacity would not have the same amount of initial field due to the armature current passing through the series coils, as would a meter of small capacity. Strictly speaking, and were no provision made for it, this would be quite true, but in cases of this kind the initial torque is maintained by the insertion of what is termed the shunt field coil, wound inside of one or even in some cases of both the series field coils. In cases of this kind the current passing through the shunt field acts in unison with and in the same direction as the series fields, and then through the armature, maintaining approximately the same number of initial armature field turns and the same initial torque to counterbalance friction.

It is this nicety of construction which enables the Thomson recording watt meter, even in sizes as large as 100 amperes, actually to give a registration on loads as small as one lamp.

No difficulty is experienced in adapting the Thomson recording watt meter to all purposes. Its theory and its construction are good alike for use in all connections. Thus, there being no iron whatever in the frame, in the armature

in the field or cover of the meter, its accuracy remains unchanged with the same calibration, whether it be installed on alternating or direct currents, and this being true, it is, of course, obvious that no variation in frequency can in any way affect the accuracy of the meter.

It may be well here to say a few words as to the watt-hour as a unit of measurement. In the watt hour we have what may be very honestly termed a universal unit. No matter what variation of voltage the meter may be subjected to, no matter whether operating upon power or upon light, whether being used to measure the output from a station or to measure the total input of electrical energy into a house having but three lamps, the watt-hour means the same thing.

It has been customary with many manufacturers to adopt the ampere-hour as the unit of measurement, but the ampere-hour, while a very good thing for ampere meters, is in reality no measurement whatever of the energy used except at one fixed potential. It is a recognized fact that a recording ampere meter, except at the potential for which it is calibrated, does not accurately record the power passing through it; and so an ampere as a unit designates only half of the question. It indicates how much current has been used, but to obtain results as to the amount of power used, it is necessary to assume or determine the voltage and multiply the result.

By a fortunate coincidence the basis of charge dependent upon 1,000 watt-hours found a parallel in the familiar basis of charge for gas. That is to say experiment has shown that 1,000 cubic feet of gas will give about ten times the illumination of an incandescent lamp consuming 1,000 watt-hours, and if a customer had been paying $2 for 1,000 cubic feet of gas, he would, if he were to be charged at the same rate for his illumination, pay 20 cents per 1,000 watt-hours for his consumption of electricity.

The Thomson recording watt-meter is made for lighting or power circuits of all commercial voltages, and for primary circuits of alternating current stations for measuring the total output from an alternating machine; and for measuring the output of direct current light or power stations in sizes from 10 amperes to an instrument as high as 600 amperes capacity, one meter thus being capable of measuring the output of some of the largest generators now made.

These meters are also made to record on a singe dial the consumption of energy from both sides of an Edison three wire system, and to measure the power consumed by an electric car to check the wastefulness of economy of the motor man; in fact they are made in about fifty-five different forms, varying in voltage, amperage and in construction, according to the uses for which they are intended.

The City Railway company of San Francisco will build an electric road on Mission street.

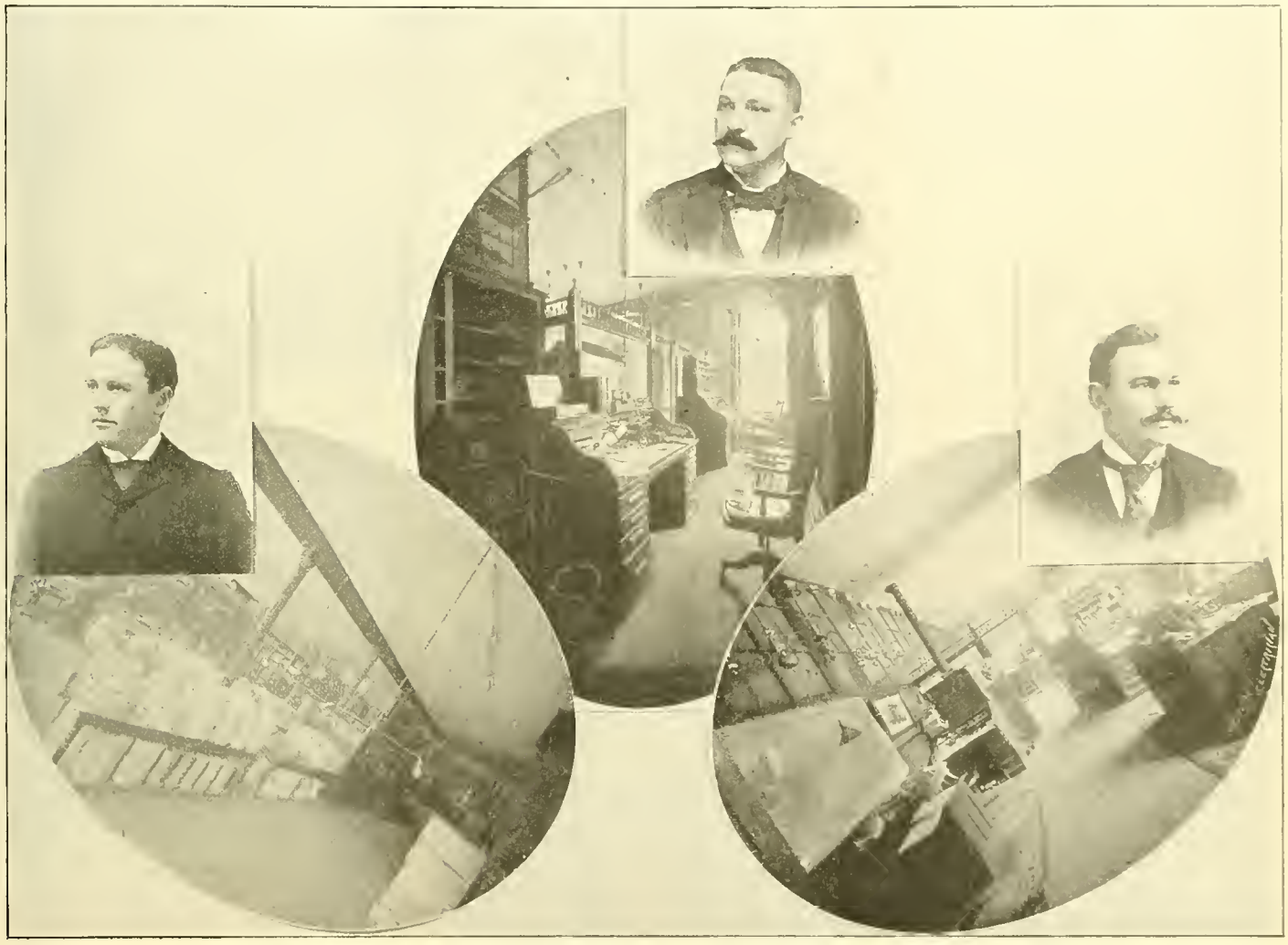
Knapp Electrical Works.

Evidence of the progress and prosperity of electrical enterprises is afforded by the growth of the great electrical manufacturing and supply houses which may be found in every part of the country and which have been established and built up during the last ten years. The importance of this industry, whether considered from the amount of capital invested, the number of men employed or the general adoption of electricity and electrical devices to every day life, is truly marvelous when it is considered that the business has been practically developed within twenty years. This is specially true in the case of the great supply and construction companies of the West. During the last ten years there has been phenomenal growth in the electrical business, especially in Chicago. An excellent example to illustrate this statement may be found in the history of the Knapp Electrical Works, which grew out of the old Railway Telegraph Supply company. Like most "electric companies" of ten years ago, that concern was limited in its operations to telegraph and signaling devices, but in this particular line it had established an excellent reputation and was doing a flourishing business. Myron A. Knapp, who became interested in the company in 1884, determined to enlarge the field of operations. Accordingly he secured control of the concern, changed the name to the Knapp Electrical Works and engaged in manufacturing as well as the general supply business. The old quarters at Fulton and Union streets, Chicago, proved inadequate, and a store and shop were taken on Franklin street, near Randolph.

At first only a small part of this building was occupied. On the ground floor the offices, salesroom and storeroom were located. At that time, it may be mentioned, the business did not warrant the carrying of the immense stock which is necessary to-day. Then again, the shop which occupied the floor above was only a small beginning. A few men were employed, but at that time it was considered quite an undertaking to conduct a shop in connection with a supply house.

This shop, which was established on such a small scale, has kept pace with the development of the business in other departments, and today may be classed as one of the largest and best equipped electrical factories in the West. Two views are presented in Figs. 1 and 2, showing the general assembling room and the department for making special devices. The manufacture of telegraph instruments continues to form an important part of this business, but with the growth of the other departments the relative importance of this specialty has, of course, decreased. There are several other important departments in the factory equipped for the building of annunciators, fire alarm and district messenger boxes, switches and rheostats, and call bells. Each of these is under the direction of competent men.

Like the factory, the supply department has grown rapidly and has necessitated many changes in the arrangement of the establishment. Today the Knapp Electrical Works occupy the entire building at 54 and 56 Franklin street, illustrated in Fig. 3. It is a four story structure and is well adapted to the business. On the ground floor are the general sales room and the shipping department. A view of the salesroom is presented in Fig. 4. On the second floor are the general offices, and in the rear are store rooms. A view of the general offices, together with the private office of the general manager, is also presented in Fig. 4. The two upper floors are occupied by the factory, views of which are given in Figs. 1 and 2.



M. B. Austin. Salesroom. General Manager's office. Myron A. Knapp. General offices. J. B. Wood.

FIG. 4. KNAPP ELECTRICAL WORKS.

The growth and prosperity of the Knapp Electrical Works is due, in no small degree, to the energy and perseverance of the general manager, Myron A. Knapp. It was Mr. Knapp who conceived the idea of extending the business of the old Railway Telegraph company and making a general electrical supply and manufacturing concern out of that company. The task of forming and developing the new corporation rested entirely upon him, and he has given the management of the concern his personal attention. Before coming to Chicago Mr. Knapp had been associated in the lumber business with his father. He was born in Wisconsin and received his education at Racine college. Mr. Knapp is a member of the Chicago Electric club, and has for several years been a member of the board of managers. He enjoys the confidence and esteem of his business associates, and is one of the most popular members of the electrical fraternity of the West.

J. B. Wood, assistant manager of the Knapp Electrical Works, is one of the most promising young men in the business. He began his electrical work in the office of the Northwest Thomson-Houston Electric company at St. Paul in the fall of 1888, and as he at once showed an aptitude for the work, was given a responsible position on the road after he had been engaged with the company but a few months. In 1890 Mr. Wood came to Chicago to accept a lucrative position on the road for the Great Western Electric Supply company, with which institution he was connected until July, 1892, when he entered the Knapp Electrical Works as assistant manager.

Merritt B. Austin, who occupies the position of special agent of the Knapp Electrical Works, is about 24 years of age. He began his experience in the electrical business six years ago in the employ of the Western Electric company. During the six years of his connection with the Western Electric company he gained a large experience in the business, and has been particularly successful as a salesman.

Edison Meter.[1]

By John F. Gilchrist.

With the first appearance of electricity upon the market of the world as a commercial commodity came the demand for an electricity meter. Business men were interested and enthusiastic over this new force which was attracting the attention of so many of their scientific brethren. They were anxious to see it developed and to assist in procuring the benefits which would result to the world, but when the time came to offer it to them as an article of commerce, something to assist them in their business and for which they must pay, they were none the less exacting. If electricity was on the market to be bought and sold as merchandise, there must be some way devised to measure it, or placing it in some tangible form, so that it could be transferred from one to another for a price, so that buyers would know whether they were getting the full worth of their money or not. Here was a hard nut for the electrical men to crack—but crack it they must, for all the plans for doing business without a means of exact measurement were showing defects and proving unsatisfactory both to producer and consumer. A meter must be devised.

Naturally, in their labors in this direction their first thoughts were something like this: In what ways does this current make its force known which are subject to control and observation? By what facts can an idea of its force be estimated? It creates heat in conductors, it excites magnets, it decomposes water and by combined chemical and mechanical application of this last law it will deposit metal from one plate or electrode to another. This last named action of the current, known as electrolysis, was the one with which it was most easy to experiment, and it was soon found that the quantity of metal deposited by a given current in a given time was constant, and that the amount of current was accurately measured by the weight of metal deposited. Here then was something to work on, and from which has come the electrolytic meter, a meter for continuous current of constant potential, in which the amount of current passed is determined by the weight of metal deposited on small plates submerged in a metal solution by the electrolytic action of the current.

When the first experiments were made with the chemical meter the entire current to be used was conducted through the measuring bottles, but this was soon found to be not only impracticable, but unnecessary, and a high resistance circuit, of which the measuring bottle formed a part, was connected in shunt with the main line, so that only a small percentage of the current measured was conducted through the bottles.

Numerous experiments have proved that absolutely accurate measurements can be obtained, even in cases of very small amounts of current, by passing a $\frac{1}{1000}$ of the entire current through the measuring bottles, and from that up to $\frac{1}{10000}$ in the case of heavy currents.

In theory this might be carried out to infinity, and even in practice to a much smaller amount than already indicated, if the most favorable conditions of operation could always be relied upon, but under ordinary conditions it is unsafe for the obvious reason that any slight increase of resistance which may occur in the bottle shunt creates an error which is greatly magnified in the main circuit. The change referred to was made before the meter was put into practice, and no radical changes have been made since. With the exception of small details of construction intended to facilitate operation, the meter is the same to-day as when first brought out.

The first Edison meters constructed were made of tin, shallow rectangular boxes designed to be fastened upon the wall. The boxes were provided with hinged doors of the full size of one side of the meter. The meter was divided by a shelf into two equal compartments. In the lower space were placed the heavy conductors, extending from one side to the other. The ends of these conductors were set in binding posts made to admit and secure the main circuit wires. To these binding posts the small wires of the shunt circuit were fastened. This smaller circuit included a resistance coil and the measuring bottles, the latter being connected in circuit by flexibles provided with binding posts at the loose end to be fastened to the rods of the electrodes in the bottles.

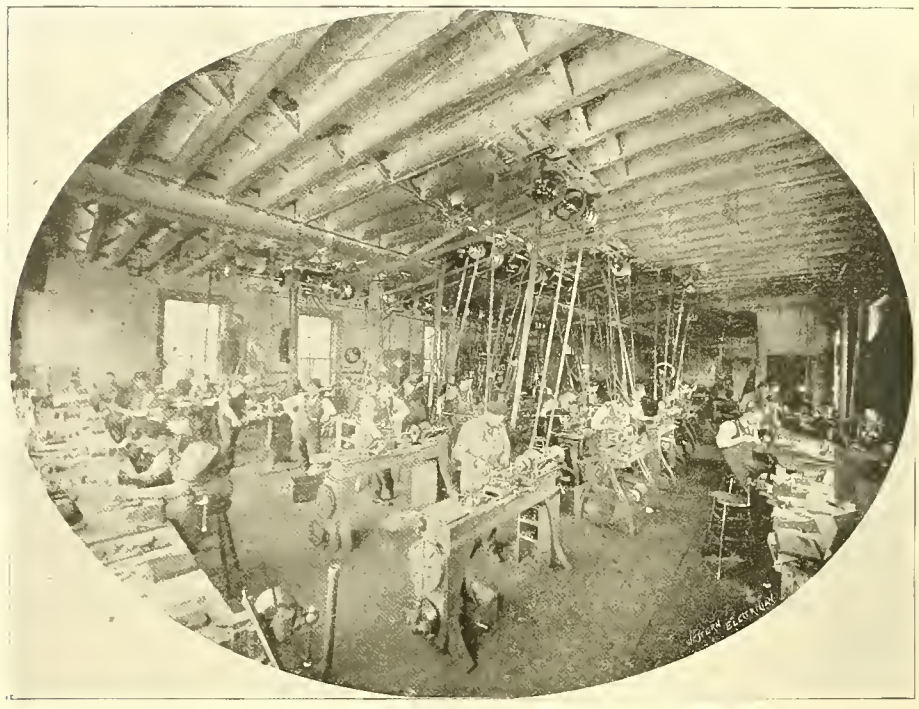


FIG. 1. KNAPP ELECTRICAL WORKS.

FIG. 2. KNAPP ELECTRICAL WORKS.

Operation proved that improvements could be made. The metal case, which demanded great care in insulation, and which also proved too flimsy to stand the work, was discarded, and a substantial wooden case somewhat larger took its place. The flexible connections for receiving the measuring bottles required too much time to adjust, and also had the bad habit of getting their heads together and short circuiting the bottle, or, worse yet, getting mixed with the opposite pole and putting out the customer's lights, so that in these new meters metal clips or strips of spring copper were substituted, fastened to the back of the meter and projecting forward in a way which admitted of being sprung up and down, but rigid as regarded lateral motion, and were placed just far enough apart so that the ends of the bottle electrodes could be placed beneath them and thus close the circuit when the bottle itself stood upon the meter shelf.

The three-wire type of this meter, is simply two two-wire meters placed in the same case; the two left-hand bottles measuring the current of the upper outside wire and the two right-hand measuring for the lower one. The two bottles on one side are wired in multiple with each other, and the circuit is thus formed in multiple with the main conductors; thus the two bottles should read the same, one acting as a check upon the other. The resistants used in these meters are small coils of copper wire varying in resistance according to the size of the meters, or rather the size of the main conductors, so that the ratio of resistance of the bottle circuit to the resistance of the main circuit is the same in all sizes of meters, namely, as 1 is to 974. The measuring bottles resemble a patent fruit jar in appearance, having a glass cover provided with two small holes for the rods of the electrodes and held in place by metal screw rings, while a rubber gasket and small corks fitting over the rods into the holes in the cover prevent the fluid from spilling or evaporating. Each bottle is equipped with a pair of plates or zincs, small rectangular pieces stamped out of ¼ inch metal and having a copper rod screwed into one end for the purpose of making contact. These plates are provided with small holes, through which pass the rubber bolts which fasten the pair together, while small rubber fittings prevent their coming into actual contact with each other. The bottles are filled so that the zinc portion of the plates is entirely submerged with a light solution of zinc sulphate. These bottles and plates vary in size according to the amount of current they are designed to measure. The smallest ones are constructed to measure a three ampere current, holding a quarter of a pint of fluid and the plates having an electrolytic surface about ¾ square inch. From this they increase in pressure by geometrical progression, the largest bottles holding over a quart of fluid and weighing, when prepared, five pounds.

This is the meter which is most largely used in Edison stations to-day, and is very satisfactory, with the single exception of being quite expensive to operate. The last meter brought out by the Edison people, known as the standard meter, has still further lessened the labor of operation, and would be more generally used were it not for the fact that it is constructed to use a heavier solution, so that it is not wise to use it with the old meter when all are operated from the same room, as a chance for error is cre-

1 Read before the Chicago Electrical Club, January 17, 1893.

ated by getting the solutions mixed. In this meter the bottles are placed in the lower part of the meter, which is an improvement over the old style for several reasons; the fluid from the broken bottle cannot drip into the zigzag of the main conductor, and thus eat it out by the action of the current; there is less danger of the meter man making an accidental short circuit on the main wires if he is not obliged to reach up over them in changing bottles, and as meters are generally placed above a man's head they are easier to read. But the change which most facilitates operation is the use of one size of bottles in all meters. This is accomplished by varying the ratio of resistance between the main circuit, and the bottle shunt in the meters of different capacity.

Whereas in the smallest meter the ratio is that of 1223:1 and a deposit of one milligram on the plates means that one ampere hour of current has passed on the main wires, in the largest meters the ratio is that of 9784:1, and one milligram on the plates means that 8 ampere hours of current have passed in the main circuit; this of course requiring a different constant for each size of meter when making out bills.

In this meter the bottles are about the size and shape of a whisky glass, and have a large cork instead of a glass cover, and rings of the old style bottle, by which much labor is saved.

The plates also are something of a departure in size and shape. When this meter was brought out the confidence in the chemical meter had become so great and the system of bottles in multiple used in checking showed so little variation from absolute accuracy that the second bottle in the smaller size of meter was deemed unnecessary, and was discarded.

Aside from these changes the meter is the same as before, being made in about the same sizes and of the same material. In the Edison meter everything depends upon operation, and in order to operate well the first and greatest requirement is one which has not up to the present time

FIG. 3. KNAPP ELECTRICAL WORKS.

been fully appreciated, namely, a spacious and commodious meter room, well provided with necessary apparatus and furniture, good light and all the red tape and system in the matter of handling that can be used.

For the sake of getting an idea of the necessary work and care let us follow a set of meter bottles through the mill. The zinc plates are first ground in order to clean and brighten the surface. For this a sand paper is used, run by a motor; then the tops and joints between the plates and rods are carefully painted with asphalt varnish to protect the point from the action of the mercury. After grinding and painting the plates are amalgamated, then brushed off carefully with a stiff nail brush or, better yet, a revolving brush, and placed in racks to dry over night.

When the mercury is thoroughly dry the plate is found to be covered with crystals of mercury. These must be removed before weighing. This is done by polishing them on a scratch wheel or steel buff, which removes the crystals and leaves a clean smooth surface. The plates are then wiped off with a clean crash towel to remove dust and particles of mercury and are turned over to the scale man to be weighed.

The scales used for weighing plates are the finest assayer's balances, laboratory style, and will weigh to 1-10 of a milligram. Here the plates are weighed, each one having attached a tag bearing the name of the consumer, the weight of the plate and a letter designating the position of the bottle in the meeting. Only one plate in each bottle is weighed. The plates are then made up, that is, fastened together by rubber bolts, placed in the bottles, which are filled with fluid and the covers adjusted; the bottles sorted into sets, and placed in cases, ready to be carried out to the meters. In putting the bottles into the meters the only care necessary is to see that good contact is made between rod and clip, and that the bottle is so placed that the weighed plate in each bottle shall come under the positive pole, and thus become the losing plate. This is really immaterial, as the theory that one plate gains the exact amount that the other loses is well established in practice, but it is well to have some system, and in occasional cases where the deposit is not firm, having been deposited very rapidly, it is better to have the positive plate, as nothing but current will loosen the firm new zinc of the losing plate, while the crystals of the gaining plate may be removed by abrasion due to careless handling. The new bottles having been put in place, and the meter resealed, the old bottles taken from the meter go into the case, are returned to the meter room, knocked down, that is, plates removed from bottles and taken apart, and are put into racks to dry. When dry, plates are again weighed, the weight being entered upon customer's record

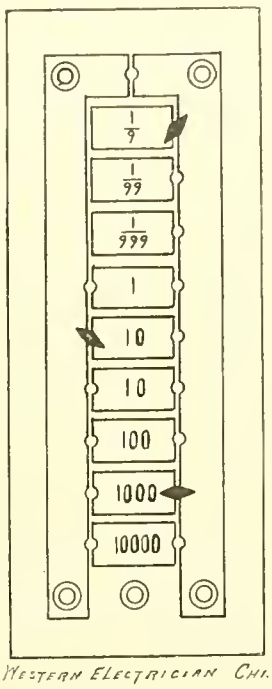


FIG. 2. A RE-ARRANGEMENT OF THE WHEATSTONE BRIDGE.

directly beneath the weight of the same plate when it left the meter room the previous month; then, having accomplished their mission, they are sent to the grinding room to go through the same form for some other meter the following month. Meter plates in ordinary use will last from six to eight months, when they become thin and small and go to the scrap pile.

Between the losses of plate from multiple bottles an average is taken, and from this the bill is easily figured, using for convenience a previously figured constant. The action which takes place between plates when current is passed through the bottle, and upon which the entire system is based, is the same as that employed in electroplating. As we say in explaining to customers, it is a chemical action, which amounts practically to deposit of metal from one plate to the next. The exact action is this: A molecule of zinc sulphate solution is decomposed at the negative electrode; the zinc in the molecule immediately adheres to the zinc plate, while the other elements seize upon the zinc of the molecule behind, and toward the other plate, and form a new molecule; this action keeps up throughout the distance from one plate to the other until the freed element of the last molecule seizes upon an atom of zinc from the positive plate, and the chain is complete.

This action is very slow and, of course, entirely invisible, but extremely sure. Occasional cases will occur when on account of over-loading the deposit will not be good, but they are safe and are taken care of by the use of the second bottle.

Proposed Consolidation of the Leading Electric Light Companies of Chicago.

Negotiations are in progress looking toward the consolidation of the Chicago Edison company and the Chicago Arc Light & Power company. This much is admitted by President Insull of the former company, but as the matter is still unsettled no details have been made public. At the annual meeting of the Edison company the question of consolidation was brought up, and after a brief discussion it was referred to the board of directors of the company with authority to take whatever action the board might think desirable. At this meeting it was reported that the number of incandescent lamps connected with the system was 99,245. The capacity of motors operated amounts to 2,044 horse power. The total gross receipts from all sources of the business for the year was $872,665. The expenses were $551,609, and the company paid during the year four quarterly dividends of two per cent. each on its capital stock. The old board of directors was re-elected to serve for the ensuing year. The members are A. F. Seeberger, John B. Drake, Lambert Tree, E. L. Brewster, R. C. Clowry, Byron L. Smith, Robert T. Lincoln, J. W. Doane, F. S. Gorton, A. A. Sprague, E. M. Phelps. The two companies named are the largest in Chicago in the incandescent and arc lighting fields respectively and if combined would have a practical monopoly of the business.

A Re-arrangement of the Wheatstone Bridge.

The following arrangement, devised by A. F. Parks Chicago, is said to embody the advantages of the usual form of Wheatstone bridge, with the employment of fewer coils in the proportional arms. As the omitted coils are those of the higher denomination it seems to possess the additional advantages of economy of material and space.

The novelty of the arrangement, as will be seen from Fig. 1, which shows the apparatus and connections diagrammatically, consists in so placing the coils that any one may be inserted in either arm of the proportional part of the bridge, as may be desired. By bringing one end of all the coils to a common terminal and fastening the other ends to their respective blocks, as usual, by the disposition of blocks and side bars, as shown in Fig. 2, it is possible to throw a coil into either arm by simply plugging between it and the terminal block of that particular coil.

Fig. 2, showing a combination of proportional coils and shunt coils for galvanometer, is intended more to illustrate the method of plugging than as a desirable form for use.

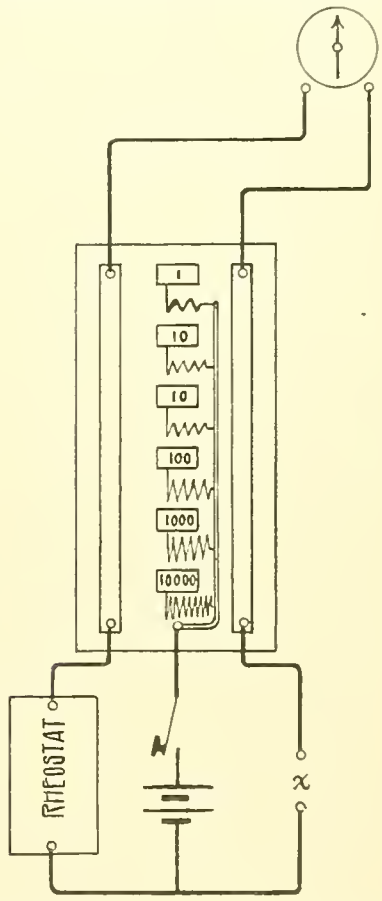


FIG. 1. A RE-ARRANGEMENT OF THE WHEATSTONE BRIDGE.

The possibility of forming unusual proportions by the grouping of the coils in parallel suggests itself, but Mr. Parks believes that the necessity for these would seldom occur. One of more or less value could be obtained by plugging the coils used for "even bridge," in parallel, when values of 1 5, 1-20, 1-200, 1-2000 and their reciprocals are at command. While this supposes the duplicating of the 10 ohm coils, it is unnecessary to add that any of the others might have been doubled. With the connections of Fig. 1, and the plugs inserted as in Fig. 2, it is apparent that the values of the unknown will be equal to 100 times the reading of the rheostat.

The business of the Chicago Edison company, believed to be now the second largest incandescent lighting company in the country, is increasing rapidly. Contracts for lighting new buildings have recently been signed as follows: Isabella, Van Buren street, 1,000 lights; Wachusett, Dearborn street, 3,500; Katahdin, Dearborn street, 3,100; Teutonic, Fifth avenue and Washington street, 1,300; Hartford, Madison and Dearborn streets, 2,000. All of these buildings will be supplied with current from the company's down-town station. Wiring has been begun only in the Hartford building.

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EXPLOITERS of telephone systems who have been waiting for the expiration of the fundamental patents controlled by the Bell company are rejoicing over the fact that the English patent on the Blake transmitter expired last week. This does not seem to worry the Bell company, as it professes security in its position, owing to numerous patents which it owns on improvements that are considered indispensable in the conduct of a telephone exchange to-day.

No one need lack information on the subject of electric meters who will study the papers presented in this issue. C. D. Haskins writes on the general subject in an Institute paper, while in a symposium before the Chicago Electric club Mr. McFadden treats of the Thomson meter, Mr. Gilchrist of the Edison meter, and Mr. Wirt of the Aron meter. A large amount of interesting information on this subject is thus presented, enabling the reader to form an intelligent judgment of his own.

April 1st should be an important date to electricians the world over, as on that day the World's Electrical Congress will assemble in Chicago. In common with Great Britain, Germany, France and Austria, the United States is accorded five official delegates. The representatives of the different nations are to be named by their respective governments. This would seem to indicate that in the case of this country the president will be requested to make the nominations. These positions should rightfully be considered of great honor and should be filled by men thoroughly representative of electrical science as developed in various parts of the world. The danger in a gathering of this character is that it will simply be a case of "much cry and little wool." However, if a thorough discussion can be had before the assembling of the congress and the right kind of men are appointed as delegates—not men with hobbies, to be ridden to the end at all hazards, but men who are ready to make and receive suggestions in a broad spirit, to the end that at least some deficiencies and inaccuracies in the nomenclature may be rectified—we may be able to look back to the Chicago congress of '93 as marking an important step in electrical progress.

RAPID transit in New York has received a set-back from which it will take many years to recover. The commissioners have virtually surrendered to the Manhattan Elevated Railway company, and that corporation will continue to serve the public as best suits its purpose. The commissioners were unable to dispose of the franchise for the underground system, the plans for which were the result of two years' work, entailing vast expense to the taxpayers of the metropolis. Advocates of the underground system will endeavor to secure the passage of an enabling act at Albany providing for the building of the road by the city, but those who are familiar with the workings of the New York legislature and the vast influence wielded by the Manhattan company, do not expect relief through this channel. A temporary advantage may have been gained by the action of the commissioners in granting additional privileges to the "L" road, but the people of New York cannot hope for permanent relief until an underground system, such as is contemplated by the commissioners, plans, is built. It is questionable if any real advantage will result from the "extension and improvement" of the present "L" system, provided for in the commissioners, concession to the Manhattan company.

IN his paper before the Chicago Electric Club, January 16th, which is presented elsewhere in this issue, Mr. McFadden calls attention to the necessity of adopting a standard unit of measurement. He says: "In the watt-hour we have what may be very honestly termed a universal unit. No matter what variation of voltage the meter may be subjected to, no matter whether operating upon power or light circuits, whether being used to measure the output from a station or to measure the total input of electrical energy into a house having but three lamps, the watt-hour means the same." The same subject is discussed by Mr. Haskins in his paper before the institute, January 17th. "How very meaningless for work of thiskind is the ampere unit," he says. Continuing on this topic he adds: "Had we but one standard voltage in use for lighting and for power, and for other purposes, no unit could be better than the ampere-hour for meter measurement; but unfortunately or fortunately, as the case may be, there is scarcely a potential, between 5 and 2,000 volts, which does not more or less imperatively call for measurement by meter to-day, and if the ampere unit is to be retained, then it will become necessary to reconcile ourselves to the use of an endless number of constants, or to a still more endless schedule of ampere-hour rates." Concluding his discussion of this important point, Mr. Haskins says: "I venture to assert that careful consideration will invariably show that the watt is the only true unit for the measurement of electricity by meter."

Here is a subject in which central station managers, manufacturers and consumers are equally interested. It should be definitely settled by the adoption of a standard unit.

A CORRESPONDENT of London *Industries*, who signs himself "A Saddened Reviewer," writes to that journal to complain of the flood of worthless electrical books on the market. He asserts that "These works come in for review in shoals. I let them collect for a short time until I have a clothes-basket full, and then spend a miserable quarter of an hour reviewing them. They are all alike in having the same illustrations of obsolete machines and the same letterpress; the only difference is in the errors introduced." Of the good book, written by a competent author, the reviewer says that it is so rare that it need not occupy attention. He concludes his communication as follows:

The great fault to be found in electrical books generally is that they are usually written by the wrong men. A book on electric light should be written by an experienced electric light engineer, not by some one who wants to found a reputation as an engineer on his book on the subject. Similarly, a book on dynamos should be written by a designer of dynamos, and so on. I do not quite know who should write the popular book on the applications of electricity to the welfare of people in general, but it certainly should not be entrusted to the inexperienced writer who thinks that a superficial knowledge on his part is sufficient to give the reader general information. Nothing is more difficult than to write a really good elementary popular book that shall be easily understood and be scientifically correct. No man who cannot write an advanced treatise is able to write an elementary primer. As to the college text-book, presumably the lecturer who really teaches electricity should write it, but I doubt whether there is such a person. Certainly the teacher who is directly or indirectly concerned with examinations is never able to write a book which is to impart information. One word of advice to budding authors on electrical subjects and I have done. Let me ask them, when tottering on the brink of authorship, to follow *Punch's* advice to those about to marry.

Although this criticism is too sweeping in its character and is evidently written in a whimsical vein, it contains much well deserved censure which is as applicable in America as on the other side of the Atlantic. It is very true that books by practical, experienced men are the ones most needed, instead of works intended to promulgate class-room theories. The helpful books are those that assist the student, the mechanic or the engineer in the work he has in hand, and these can only be written by men who have a comprehensive working knowledge of the subject they essay to teach.

A RARE treat was afforded readers of current electrical literature by the article on the "Construction and Operation of Electric Fountains" published by the *Electrical World* last week. To be sure there was but little about the electric fountains at the World's Fair, which were evidently intended as the basis of the article, and that little was inaccurate, not new and, according to the statement of Luther Stieringer, the designer, published in breach of faith. But although unreliable, the compilation was very entertaining. For instance, how exciting to be thrilled by the bold assertion that "To Thales, of Miletus, the earliest of Grecian philosophers, himself of Phœnician descent, however, is given the credit of first having observed the electrical properties of amber when briskly rubbed." How new and strange!

But it is not alone in originality that the writer excels. The tales of Greek mythology afford a tempting field for the exercise of his talents, and we find our study of electric fountains enlivened by two stories from the classics. The first, the tale of Alpheus and Arethusea, naturally leads to a reflection on modern sociology, and we read that "This junction of the fountain to the mightier river is beautifully symbolic of the marriage relation of the present day, in which the dependent bride leans upon her sturdier spouse for support and sympathy in her varying moods." The sentiment is somewhat trite perhaps, but who can question the appositeness of its introduction in an article on the "Construction and Operation of Electric Fountains"?

It would be manifestly improper to describe the "Construction and Operation," etc., without invoking the aid of poesy, and he who looks for the swelling sentences of the singer will not seek in vain. To illustrate this we select two stanzas:

The beautiful effects of the splashing water, the murmer of its trickling streams, the increasing restlessness of its pulsating jets, were a fitting setting for the dreamy personifications which the fertile oriental mind conjured up. Thus has the sculptor found here his greatest inspiration, and the beautiful myths of long ago are again endowed with life, and the stone or bronze is made to speak as was the beautiful Galatea in answer to the prayers of Pygmalion. But, since the early times, the setting of the sun marked the close of the day, these speaking fountains became mute as the veil of night was drawn, only to be awakened to consciousness again by the gentle touch of Lucifer, Aurora's avant courrier.

Since our modern civilization has converted night into day, so have the hours of life of the fountain's play been prolonged by the rays of artificial illumination. New and beautiful effects were produced by side lights, and the poetic instinct clothed the flowing waters with a halo of mystic meaning and association that have stimulated our inner thoughts to flights of fancy, less sensuous in its degrading sense, more sensuous in its nobler imagery.

Here, indeed, is true poetry, not to be disguised by the prose form of expression, which, in fact, merely brings out more fully its beauties. The poetical form is also very gracefully employed at the close of the article, where a meed of praise is laid at the feet of all who have had to do with the electric fountains at the fair, these words being employed: "In conclusion it is only necessary to say, what all have been led to expect, that this, perhaps the most beautiful feature of the coming exposition, has been most nobly planned, and the laurels that will be theirs will be a crown of glory well fitted for deserving heads."

For paucity of facts voluminously enshrouded in the mantle of "fine writin'" the *World* article stands unsurpassed in the annals of electrical newspaper work. In this respect it may indeed be said to possess "a crown of glory."

Electrical Recording Meters.[1]

By Caryl D. Haskins.

Part I.

The earliest meter patent was granted in 1872 to S. Gardner, of New York city, and the principle of a magnetic or electro-magnetic release for a simple clock movement is preserved in two or three so-called time-counters to-day, and is doubtless very useful for many purposes; as, for example, in the Spaulding clock for registering the hours of use of a motor or other similar devices for registering the hours of use of arc circuits. These devices I shall neglect. They are not meters within the true sense of the word, and their simplicity is obvious.

Before undertaking any description, a few words may be appropriately devoted to the question of the unit by which it is most desirable to measure electrical power in use.

The ampere has been the popular unit for the measurement of electricity supplied; yet, on careful consideration, how very meaningless for work of this kind is the ampere unit. Had we but one standard voltage in use for lighting and for power and for other purposes, no unit could be better than the ampere hour for meter measurement; but, unfortunately or fortunately, as the case may be, there is scarcely a potential, between 5 and 2,000 volts, which does not more or less imperatively call for measurement by meter to-day, and if the ampere unit is to be retained, then it will become necessary to reconcile ourselves to the use of an endless number of constants, or to a still more endless schedule of ampere-hour rates.

We wish to measure power delivered; in fact, we wish to know how much coal a group of lamps is consuming. This points directly to the watt, and I venture to assert that careful consideration will invariably show that the watt is the only true unit for the measurement of electricity by meter, unless, perchance, we adopt the cubic foot, as has at least one central station in the United States—a very amusing but equally practical demonstration of American ingenuity.

The earliest successful meters, if we consider classes rather than individual instruments, were the chemical meters, closely followed by thermo-meters.

The chemical meter is obviously capable of giving most accurate results; in fact, with proper manipulation, it is very doubtful whether any measuring device which has up to to-day been designed could more correctly sum up passing power. It is in the manipulation and care which such meters require that their fault lies—if faults there be.

An electro-plating bath in its meter form as generally used does not, however, give a dial indication, and the consumers ask for a dial indication almost invariably, unless they have already become thoroughly familiarized with Edison meters as used by many large Edison stations.

Many very ingenious and some quite successful attempts have been made to actuate a train of gears by the electro-deposition of an electrolytic bath. Thus, we have two electrodes suspended at the opposite ends of a walking beam. This walking-beam is in various ways connected with a pole-changer, and as but a small portion of the current being measured passes through the true meter (for of course almost all chemical meters are shunted) the pole-changer is not perhaps a very serious objection.[2]

The action of such a meter as this is obvious. We have a deposit from one electrode on the other, until the second electrode becomes the heavier, when the beam tips and the recording device is set one notch ahead. The pole-changer is thrown over and the deposit takes place in an opposite direction, the former plus electrode becoming the minus, and so on. This device deposits and reposits the same zinc, or rather electrode material. Again we have a modification of the same device in the form of a wheel bearing a number of electrodes, and on the same principle setting up continuous rotation.

It should be noted that in this first digression from the chemical meter we at once meet with the prime factor of difficulty in all motor meter construction—that of friction, which, if uncompensated, must invariably introduce more or less serious error.

Another form of self-registering electrolytic meter has a cathode plate suspended from a spring-balance, an ordinary sensitive spring weighing machine, and the heavier the cathode grows, so much greater is the registration of the spring indicator. This device is perhaps preferable to the reciprocating movement just described, but is limited in the capacity of the spring, and probably lacks sensitiveness to small amounts, being dependent, of course, solely upon the nicety of construction in the spring-balance.

Mercury has at times been employed in the construction of electrolytic meters, and with at least moderate success, for with a mercury anode and a cathode of the same or other material, a record easily measured may be obtained, and such a meter may even be made self-registering in a graduated tube or by half a dozen other more or less simple means. Such are the more typical electrolytic meters.

Another form of chemical meter formerly quite popular among inventors depended for its registration upon the decomposition of water, generally acidulated water, and sometimes upon the decomposition of more volatile substances. This class of meter may very properly be divided under two heads:

First, those meters simply dependent upon the measurement of the gas developed by the decomposition of water through any gas registering device. In fact, we may say that such meters are mere decomposing baths connected to a gas meter. There are some devices of merit which may be classed under this head, but the principle is probably not commercial, for we have nothing very successful of this kind in use to-day.

One of the more ingenious meters of this kind provides a diagonally placed rotating wheel with pockets; the decomposition takes place directly under each pocket progressively, and as the air pocket fills with gas, the wheel rotates sufficiently to free this gas at the surface of the fluid, bringing another pocket into place. Others have a rising and falling diaphragm like the popular gas meter, and still others a delicately poised air fan over a minute aperture. This last device is obviously most inefficient.

The second group of meters under this classification brings us to the thermo-meters—a typical group containing a few meters of more or less pronounced merit.

Those thermo-meters, depending upon volatilization of a fluid, generally have two or more sealed bulbs partly filled with some volatile fluid, as for example, naphtha or ether. When two such bulbs are used, they have generally been mounted on a walking-beam mechanism combined with a pole-changer, each bulb containing some kind of a rheostat or heat developing device dependent for its heat on the current passing through the meter, the two bulbs communicating with one another. The rheostat in but one bulb is in circuit. The heat developed in the rheostat in circuit volatilizes more or less rapidly the fluid contained in this bulb, according to the current passing through it. The gas developed either passes in gaseous form into the second bulb and condenses, or else, as is more common, forces the fluid remaining by the simple increase of pressure into bulb No. 2, which at once becomes heavier and causes its end of the beam to fall. This throws the pole-changer, and the rheostat in the second bulb is thrown into action, repeating the operation as just described. To be successful, such a device must be very sensitive, and to be sensitive, the construction must be of a more or less expensive character, and so delicate to be to a greater or less degree prohibitive. Like the walking-beam meters just described, instruments of this class have been designed with a number of bulbs mounted on a rotating wheel; the same actuating principle holding true for all such devices.

Another ingenious form of thermo-meter, no longer in any sense a chemical meter, is an instrument dependent for its action upon the heat in a confined but circulating atmosphere. Thus a rheostat dependent for its heat upon the amount of current passing is so arranged as to heat a body of air, which, by the peculiar construction of its receptacle, at once commences to circulate more or less rapidly, dependent upon the heat. It is obvious that if a delicate air fan, a screw propeller in fact, be suspended over such a circulation of air, its speed would increase with the speed and volume of circulation, and one of the most ingenious and most interesting meters that it has ever been my good fortune to see is the Forbes meter,[1] constructed on this plan. But here friction is the most serious consideration; the torque obtained in this manner being necessarily small.

While the Forbes meter cannot perhaps be properly considered as a motor meter in the true sense of the word, it still must be classed as such in a certain sense, and I think it may safely be accepted as an axiom that to be successful in practical operation, a motor meter of any kind must be of high torque, for it is only by the combination of high torque and compensated friction that accurate results can be obtained on light loads. I might say that almost anyone can build a meter which will record fairly accurately on heavy loads; the difficulty is to build a sensitive and accurate meter for very light loads down to one lamp.

Another ingenious and quite positive form of heat meter consists of two metallic rods, or in some cases of two bimetallic rods, somewhat similar to an ordinary thermostat; such meters being in fact a similar application of the thermostat principle to a recording device. Two rods of this kind may be placed vertically, one under each end of a walking-beam mechanism, the familiar pole-changing device being again brought into play to throw the current first through one rod and then through the other. The character of the walking-beam must be such that only a slight movement is needed to actuate the recording mechanism and also the pole-changer.

The method of operation of a meter of this kind is obvious; the alternate expansion and contraction of the two rods, as they are thrown in and out of circuit will occur with a rapidity dependent upon the current passing, and, as each rod lengthens, it throws over the walking-beam on the shorter cool rod, and the same action follows from that side.

I think no comments are needed on such a device as this; it probably lacks sensitiveness to a marked degree and it has other objections which are sufficiently apparent.

Probably better than this is the system of bi metallic rods with one contracting and one expanding side, which bend to right and left, or up or down, with a rapidity depending upon the strength of the current, a pole-changer, of course, being used as before.

The method of actuating a train of gears by this system is comparatively simple, and not open to as many objections as the device just described.

I have neglected to state heretofore that the bulk of the thermo-meters are actuated on the shunt principle.

It is obviously out of the question to operate a pole-changer by means of a meter, which shall cause one to break the full current passing to the lamps. As a rule a very small portion of the total current is carried through the meter around a positive shunt. Instead of shunting the current, this device has at times been applied to alternating work by the introduction of a kind of transformer, which takes a few turns of wire in series with the lamps and transfers the energy through a secondary to actuate the meter; thus the meter is not on the lamp circuit at all, but on the independent secondary. But this intervention of induction is probably not desirable in cases of this kind.

A patent issued in the year 1889 to a Mr. Dahl tells us of another quite unique form of thermo-meter, and this is probably the only heat meter actuated by an actual field and armature arrangement. In [illegible] the inventor provides a field of iron excited [illegible] few series turns on the lamp circuit. The strength of the field should therefore bear a more or less definite relation to the amount of current passing through it; [illegible] will not comment upon how direct this relation would be. It will suffice to say that the introduction of iron in the construction of any meter of this character is probably detrimental to its accuracy to quite a marked degree. This, however, is aside from the subject in hand.

On a shaft in the meter which we are describing is suspended a kind of armature consisting of a flat disk-like ring of iron, supported by a number of spokes and mounted as a wheel; in fact it is mounted on a quite ordinary shaft mechanism suspended in proper bearings. The iron portion of the wheel rotates between the poles of the electro-magnet, or at times permanent magnet, just described. We have, in fact, a disk armature rotating in such a manner as to pass between two poles of a more or less strong field. On the principle of the familiar thermo-magnetic motor, rotation is obtained in this meter by so placing coils of wire or other suitable material under certain portions of the disk and in series with the lamp circuit that the disk is differentially heated at the proper point; thus, with the peculiar armature construction described, a thermo magnetic action is set up, somewhat akin probably to the action of the thermo pile. The portion of the disk heated is attracted toward the field coils, and thus the disk being progressively heated and cooling rapidly owing to its thinness, continuous rotation is set up. Sometimes in this construction the field is in series with the heating device and sometimes the heating device alone is in series with the lamp circuit, and the field is either a permanent magnet or independently excited by a battery. Neither of these changes involves the principle of the meter, which is assuredly ingenious.

As in almost all other of the arts, electric meter construction shows the definite mark of evolution; thus, one class of meters cannot be distinctly separated from its neighbor, the one merging into the other.

The final form, and I think I may say the last form of thermo-meter at all worthy of description, is distinctly a clock meter also. The clock meters will come under our consideration somewhat later in this paper, but the meter which I am about to describe can scarcely be separated from its kindred, the heat meters. Briefly, however, I may define the clock meter as one whose recording device or whose movement is actuated by an independent source of power, generally a clock, though sometimes a constant speed motor or other device.

I might add here, at the risk of digressing from my subject, that there is probably no known indicating device, from the Cardew voltmeter to the Sir William Thomson balance, which could not be so applied as to make a more or less accurate clock meter.

The thermo-meter now under consideration is also a thermometer (a commentary perhaps on the English language.) An ordinary thermometer of somewhat modified construction is surrounded at the bulb by a coil of wire in series, or in shunt series with the circuit to be measured. It is apparent that the rise and fall of this thermometer will be more or less dependent upon the heat developed by the coil, and the heat again will be more or less dependent upon the current passing, but, of course, the temperature of the surrounding atmosphere must necessarily introduce serious error.

Now, it has been more than once suggested, though never patented, I believe, that a constant ray of light supplied, we will say, by an electric lamp, burning when the meter is in circuit, if thrown upon this thermometer could be made to photographically mark on rotating sensitized paper, actuated by clockwork at uniform speed, a line, or rather a solid block of light whose lower termination or line of demarkation would represent the height of mercury in the tube.

Thus, we have a curve of registration which only needs to be integrated with a planometer to determine the consumption, always supposing that the indicating device is correct. I have said, "only needs to be integrated." How desirable a meter would be in practical service whose record needs to be integrated can best be left to the judgment of the station manager and the public. It is largely a matter for personal experience and personal opinion. To compensate for external temperature it was suggested that the meter be so encased as to practically insulate it from heat or cold; but this is probably not feasible.

1. Abstract of paper read before the American Institute of Electrical Engineers, New York, January 17, 1893.

2. Transactions, vol. vi., p. 32.

1. Transactions, vol. v., p. 35.

A Governor's Recommendation.

In his annual message to the Ohio Legislature Governor McKinley said: "I am deeply impressed with the conviction that the General Assembly may extend its legislation for the better protection of that increasing class of wage-workers, the street car men. Within the last few years railroad locomotion has been revolutionized by the use of electricity as a motive power. This system is in almost every city of the state, and lines are being established between cities and suburban towns. In some instances they carry not only passengers, but freight and mails. Accidents on electric and cable street railways are not infrequent, nor are they decreasing, and the companies operating them should be required by law to exercise the greatest caution, and to avail themselves of every appliance for safety and for the prevention of accidents to employes and the traveling public. The street car drivers, motormen and conductors, numbering in Ohio nearly 12 000, are public servants."

The mourning services in Berlin in honor of Werner von Siemens were attended by the Empress Augusta, the Dowager Empress Frederick, Prince Henry and Prince Albert.

Aron Meter.[1]

By Charles Wirt.

I have had a little experience with the Aron meter in the laboratory, and I am much interested in it. It is familiar to most of you, and the mechanism is simple. It consists simply of two pendulum clocks, each being run by a spring, capable of running thirty days at one winding. Each clock has a pendulum of the same effective length, giving synchronous vibrations. The pendulum of the left hand clock is weighted with an ordinary brass bob. The pendulum of the right hand clock has a permanent magnet for a bob. Those two clocks are geared on the counter differentially, so that when they are running properly and in synchronism the counter stands still. Any difference in the rate of the two clocks is registered on the counter. The electrical part of the meter is merely a pair of coils. In the meter for a two-wire system there is only one coil, and the bob is single instead of double. Those coils are close underneath the permanent magnet bob, and carry the main current. The current is so put through the coil as to magnetize the permanent magnet in the same sense in which it is originally magnetized. There is no tendency to reverse or decrease the strength of the permanent magnet. The principle of operation is simply that the attraction of the coil for the magnet acts exactly as an increase of gravity and increases the rate of vibration; so the magnetic pendulum runs faster than the other, and the difference in rate is registered on the counter. That difference in rate is proportional to the current passing; and one of the advantages of this meter is that it is capable of an infinitely fine rate of registration. It does not register down to one per cent. only, but it will register down to any per cent., no matter how small, of the total current.

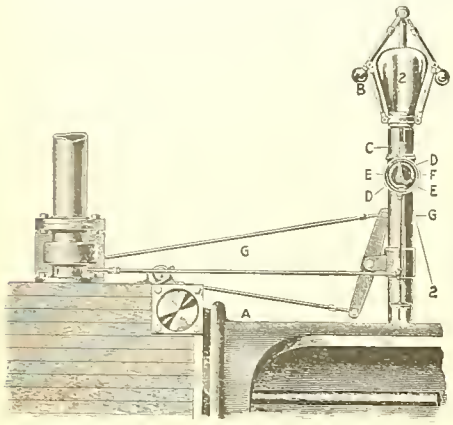


FIG. 1. AUTOMATIC SAFETY STOP FOR CORLISS ENGINES.

The extremely small difference in the rate of the two pendulums on which the reading of the meter depends is rather surprising; at full load the difference in the rate is only about one tenth of one per cent. It follows that an error in either clock work of one-tenth of one per cent. would suffice to wipe out the largest record that the meter might make. The meter working at one per cent. of the full load would give a variation in rate of only one part in 100,000.

When I took that meter to test it some years ago the first thing I wanted to find out was if the effect of the current would not be to increase the magnetism in the magnet enough to give a rate different from the rate required by theory. I found that the actual magnetic effect of the current was so small, and the strength of the magnets and the permanency was such, that the effect was not appreciable. The meter can be taken as strictly proportional throughout its range. That makes it valuable to [illegible] after having determined the rate of the meter it can be depended upon for a time to agree

The next thing I wanted to find out was whether a short circuit or disturbance in the main circuit would not so affect the magnets as to permanently alter their value, and so cause false reading. I tried short circuits and did not succeed in making any permanent change in the magnet, but I did find that by reversing the current and putting it through the meter in the reverse direction, and then making a short circuit, the magnets had been permanently changed, and the constant of the meter altered.

The constant of the meter which is sent out should be redetermined for each meter before it is put into use.

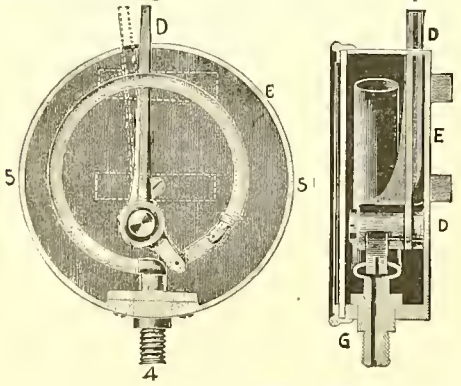
The mechanical part of this meter has been very well worked out. The clock work is admirable; it is not large, having very little work to do, much less work in fact than an ordinary eight-day clock has to do in moving the hands. But the design of the case and some of the other details of the meter are rather too clumsy to suit the American taste.

I have not had any extended experience with this meter, and I do not know to a certainty whether the magnets retain their permanency over long periods of time. The meter has never come into use in this country, probably owing to the fact that we have had good meters, and that no one has seen fit to undertake the manufacture of this one here. They are largely used in Germany, and I understand with gratifying success.

I know one central station that put in an electrolytic meter, having first tested this meter and made very careful calculation as to the cost of operating both, and concluded that the cost of the Aron meter at the then ruling price would more than off-set the gain in operating expense, and they put in the electrolytic meter.

Automatic Safety Stop for Corliss Engines.

In the accompanying cuts are shown the details of an automatic safety stop for Corliss engines, recently perfected by James Barclay, superintendent of the Sioux City Engine Works. Fig. 1 is a side elevation of the improvement as applied. Fig. 2 is an enlarged transverse section of the same on the line 2-2 of Fig. 1. Fig. 3 is an enlarged face view of the stop, while Fig. 4 is a transverse section of the same on the line 4-4 of Fig. 3.



FIGS. 3 AND 4. AUTOMATIC SAFETY STOP FOR CORLISS ENGINES.

The engine *A*, of any improved construction, is provided with the usual governor *B*, or any other governor, connected with the valve mechanism of Corliss type of engine or with the valve stem of throttling governors. The governor *B* is provided with its usual sleeve *C*, adapted to rest on a stop preferably made in the shape of a lever *d*, when the steam is shut off by the engineer. When, however, an accident happens to the governor, while the engine is running, the stop *D*, being under the sleeve *C*, permits the governor to drop sufficiently to completely shut off the steam from the engine. It is understood that the stop lever *D* supports the sleeve when the steam is shut off by the engineer closing the valve; then the valves of the engine are still in position to take steam as soon as the engineer again opens the valve to start the engine. This stop lever *D* is controlled by the motive agent, and for this purpose the following arrangement is made. The lever *D* is fulcrumed within a casing *E*, attached to the support of the governor, as shown in Fig. 1. The lever *D* is provided with an extension pivotally connected by a link with

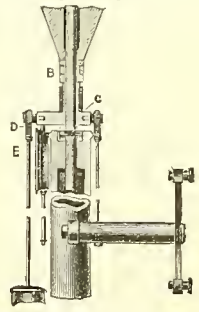


FIG. 2. AUTOMATIC SAFETY STOP FOR CORLISS ENGINES.

the closed end of a spring tube *F*, preferably bent in the shape of a segment of a circle, as shown in Figs. 1 and 3. The spring tube *F* is arranged within the casing *E*, and is connected at its open end with a pipe *G*, leading to the supply pipe or other part of the steam chest, so that the motive agent can enter the pipe *G* whenever the valve controlling the inlet of the steam is opened. It will be seen that when the motive agent passes through the pipe *G* into the tube *F*, the latter swings outward at its free end, as shown in dotted lines in Fig. 3, thus exerting with this free end a pull in the extension of the lever *D*, whereby the latter swings from under the sleeve *C*, to permit the latter to drop below its normal position in case of accident to the governor. As soon as the motive agent is cut off from the pipe *G*, by closing the valve in the inlet pipe to the cylinder, then the tube *F* is relieved of the pressure of the steam, and consequently its free end contracts so as to move the lever *D* back to its normal vertical position, as illustrated in Fig. 3, to support the sleeve *C* in a normal position. While the engine is running, the lever *D* is swung from under the sleeve *C* by the pressure of the steam in the spring tube *F*, so that in case of accident to the governor *B* the latter can drop sufficiently to throw the cams on the knock-off levers into action, so that the steam hooks cannot catch and open the valves, thus cutting off the steam supply and thereby stopping the engine. When the engine is running normally and the lever *D* has swung from under the sleeve *C*, as above mentioned, and the engineer shuts off the steam from the supply pipe, then the lever *D* swings back into its normal position before the engine comes to a stop, so that the lever *D* is ready to receive and support the sleeve *C*, thus holding the governor in the proper position for starting the engine.

The device is manufactured by the Sioux City Engine company.

ELECTRIC LIGHT PLANT AT THE CENTRAL INDIANA HOSPITAL FOR THE INSANE.

The mayor of St. Louis has signed the Scullin railway bill, which provides for certain extensions of the system in the south and southwestern part of St. Louis, and authorizes the acquisition of the Mound street and Benton-Bellefontaine roads.

Electric Light Plant at the Central Indiana Hospital for the Insane.

The cuts herewith presented illustrate the electric ligh installation in the Central Indiana Hospital for the Insane at Indianapolis. The establishment is one of unusual size, and the installation can be considered as one of the largest isolated plants in the country. The power and steam plant are in a small building 200 feet in the rear of the center of the buildings. The generating plant consists of three 45 kilowatt and two 25 kilowatt compound wound dynamos for direct incandescent lighting, and one 10 kilowatt 30 light arc dynamo, each directly connected to a high speed engine of the Phœnix type, drawing steam from three 125 horse power boilers installed by the Phœnix Iron Works.

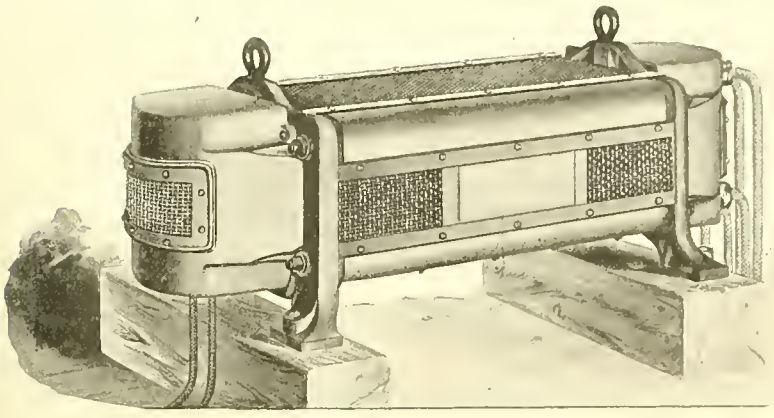


FIG. 1. STANLEY TRANSFORMER.

Three separate feeders of lead covered cable, laid underground in water-tight boxes of two-inch plank covered with insulating paint, run from the power house to each main building. Each wire lies loosely in its place and can be drawn in or out at any time. Socket bolted terminals are used where the underground cables connect to feeders in the basement, so that they can be readily disconnected for testing purposes. Rubber covered wires are carried from the feeders to the attic, and the current is fed from the attic down to the other floors. The three feeders which run to the women's department supply three separate systems: feeder No. 1 furnishes current for twelve wards south from the grand centre of the building; feeder No. 2 supplies eleven wards north of the grand centre; feeder No. 3 supplies the grand centre itself, in which are the executive offices, and the rear centre, comprising chapel, bakery, kitchen, etc. This last is an all night circuit, controlled by a switch in the superintendent's office. A similar switch controls the all night circuit to the sick ward, 600 feet north from the centre.

The wiring of an insane asylum differs materially from that of other institutions not subjected to the peculiar conditions presented by the proximity of the insane. In this case the wires are all run in molding with backing, and the cabinet cut-out boxes are set back into the brick walls. The covers are heavily raised panels of extra strength, so that they cannot be broken by the patients. Each cut-out box is furnished with a Yale lock, and each ward has its own cut-out box controlling from 20 to 65 lights.

The 2,200 lights are controlled by switches, and each switch, whatever its capacity, when operated controls an equal number of lights on each side of the neutral, with 110 volts only on each switch, so that overbalancing of the system is obviated. All lights are thrown off at the power house at ten o'clock at night, with the exception of those in the sick wards and superintendent's quarters. A special switch changes the system from three wire to two wire at ten o'clock, the smallest engine sufficing to operate the incandescent and arc dynamos after that time until morning. This switch is so connected that one, two or three dynamos can be thrown into multiple on the two wire system, together or separately. There are 70,000 feet of molding. The lamps are suspended by flexible cord pendants with keysockets and porcelain cut-outs.

The arc circuit is used to illuminate the grounds. Two miles of the General Electric company's lead covered cable, laid underground in iron pipe, carries the current to the twenty 1,200 candle power lamps suspended from 25 feet ornamental poles, well stepped. The cable runs from lamp to lamp without splices. At the bases of each pole, and four inches below the surface, is set a junction box 18 inches square. The entire system is laid out with material of heavy enough capacity to carry 3,300 16 candle power incandescent lamps, as well as the arc lamps. The installation was effected by the Chicago office of the General Electric company, and is pronounced by the trustees to be alike a "credit to the company and the state."

Stanley Transformer.

In the accompanying cuts are shown a new 500 light transformer and the details of the transformer fuse box, which are now being introduced by the Stanley Electric Manufacturing company of Pittsfield, Mass. Fig. 1 shows the new 500 light indoor transformer. It is compact and possesses marked efficiency. This type is also made for 250 and 350 lights. Fig. 2 shows the details of the fuse box. Only the primary circuit is fused, secondary fuses in the transformer itself being regarded as unnecessary. The fuse is double pole, each wire or link being carried on a separate porcelain plug or block. To replace a fuse the door is dropped down by simply loosening one thumb screw, the plug pulled out and an extra one inserted or a new fuse wire attached to the same plug. The same size of plug is used in all sizes of transformers, and all plugs are interchangeable there being no rights and lefts. To change a fuse takes but a moment or two, and is unattended by danger. The plug being held in the hand entirely away from the transformer or circuit, the new fuse wire can be fastened handily and deliberately without fear or haste and good contacts be surely made. No screw driver or plyers or any other tool is necessary. The fuse box inside the iron case is entirely of porcelain, every part being perfectly insulated and fireproof. The two fuses are entirely separated from each other by a porcelain partition, thus preventing arcing from one to the other. The peculiar form of plug used, and the unusual length of the fuse itself insures, a complete rupture of the circuit.

Incandescent Lamp Litigation.

In the United States Court at Chicago last week the hearing of the injunction suits of the Edison Electric Light company and Edison General Electric company against the Sunbeam and Illinois companies was postponed, the case of the Illinois company until January 28th, and that of the Sunbeam company until February 20th. This will give the contending parties time to prepare arguments and accumulate evidence.

The Columbia Incandescent Lamp company of St. Louis will have an opportunity February 1st to argue its case before Judge Thayer.

According to the Hartford *Times* the Mather Electric company has secured permission to use the Perkins lamp for the present in lighting the town of Manchester. This concession was made by the Edison company, in view of an order from the Mather managers for 7,000 lamps at once. The action of the Mather Electric company in removing the lamps from its factory and from the Manchester Electric Lighting company's plant was simply to obey the injunction that was granted by Judge Shipman.

A dispatch from Boston announces that the Edison Electric Light company and the Edison General Electric company have applied for an injunction against the Beacon Lamp company of that city. The latter company filed about thirty affidavits alleging that the incandescent lamp was not invented by Mr. Edison in 1879, but by Henry Gobel. The affidavits allege that Mr. Gobel, after having experimented for several years, finally devised, somewhat earlier than 1860, substantially the form of incandescent lamps now in use, and on which Edison was granted a patent. The use of this lamp was necessarily limited by the fact that dynamos were not to be had at that time, but Mr. Gobel made many of these lamps for several years prior to Mr. Edison's alleged invention, and used them more or less continuously in lighting his store and dwelling and for other purposes. The lawyers for the Beacon company contend that the Gobel use of the incandescent lamp was a full anticipation of Mr. Edison's lamp and that accordingly Mr. Edison's patent is invalid.

The National Electric Construction company, which has a small central station in the University block, Chicago, has asked Judge Grosscup for the privilege of buying incandescent electric lamps. Since the Edison General Electric company secured an injunction against other manufacturers of incandescent lamps, Manager William L. Abbott says that he has been unable to buy at any price the supplies needed by his company. "You see," he is reported as saying, "we are the only independent incandescent lighting company in Chicago, and the Edison concern is making every effort to freeze us out. Formerly we bought part of our lamps from the Sunbeam company, but since the injunction was issued that source has been closed, and the Edison people now refuse to furnish supplies to us at any price. They think they can in this way compel us to go out of business. Our petition to Judge Grosscup gives the condition of affairs and prays either that the Sunbeam company be allowed to sell to us or that the Edison company be compelled to fill our orders. While the Edison concern keeps saying publicly that it is willing to sell to any one and every one, we have applied again and again and they refuse to let us have a single lamp."

The first installment of Westinghouse lamps for commercial use has reached Chicago, although a number of the new lamps have been at the World's Fair grounds for some time. It is said that the company has orders for 750,000 lamps.

CORRESPONDENCE.

New York Notes.

NEW YORK, January 21.—The final decision of the Rapid Transit Commission, which was presented to the public last week in the form of resolutions, is a serious disappointment to all who have been expecting permanent relief as a result of the commissioners' deliberations and exertions. After two years of hard work the elaborate plans prepared under the direction of the commissioners are shelved, and the people are informed that they will be obliged to put up with "L" road service. The Manhattan company expressed a willingness to extend and improve its service, but it is not expected that this will afford any decided improvement. The commissioners have undoubtedly done all in their power to secure an underground system which would give the people rapid transit service. They have been unable to find responsible bidders for the franchise, and the arrangement for temporary improvement in the "L" road service is unquestionably the best that could be made under the circumstances. They have imposed the following conditions on the Manhattan company:

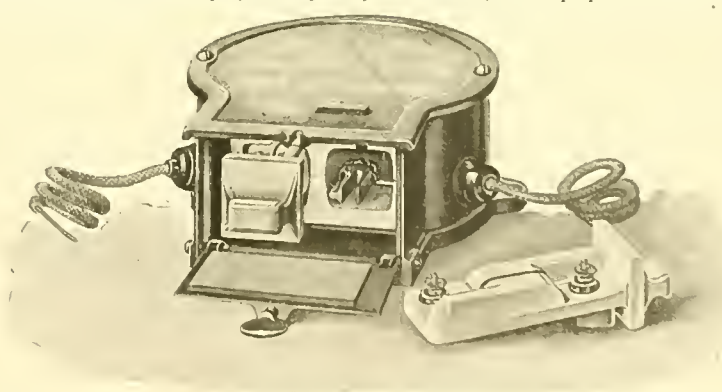


FIG. 2. STANLEY TRANSFORMER.

First—That the elevated railway system shall be so extended, within a reasonable time to be prescribed, as to

transport passengers between the Battery and the northern limits of the city on both the east and west sides at a single maximum fare of five cents.

Second—That the company shall make compensation to the city in a gross sum or by annual payments, or both, as may be determined by this board

Third—That in respect to any application which involves the use of additional avenues and streets in a large degree for the construction of new lines, the commission reserves the right to offer such a franchise at public sale.

The friends of the underground system have not given up hope, however. They have prepared petitions asking the legislature to pass an act enabling the city to build a road in accordance with the commissioners' plans. Eminent counsel will be retained to look after the interest of the bill before the legislature.

Austin Corbin has written to the commissioners suggesting a consultation of engineers, with a view to arranging connections between any underground road that may be adopted for this city and the tunnel which Mr. Corbin proposes to construct between Brooklyn and Jersey City.

A telegraph operators' "fast sending" tournament is to be held at Hardman hall, Fifth avenue and Nineteenth street, on the afternoon and evening of Saturday, March 11th. The objects of the tournament are to develop the maximum carrying capacity of a wire in first-class condition when manipulated by the fastest sending and the most expert receiving operators; to ascertain how much "press" matter might, in an emergency, be transmitted over such a wire, and to test the comparative worth of the pen and the several typewriting machines for correctly recording Morse signals transmitted at the highest rate of speed attainable. The committee of arrangements is composed of M. H. Toomey, R. L. De Akers, M. W. Russell, J. N. Johnston, H. F. Warren and Charles Orr.

W. F. O.

Milwaukee, Wis.

MILWAUKEE, January 21.—The Brown Telegraph & Telephone company is preparing to establish an exchange in this city. I. L. Moore, the assistant general manager of the new company, has been conducting experiments with the Brown telephone, using an office in the Chamber of Commerce for the purpose. The instruments were attached to the Postal Telegraph company's wires between this city and Chicago. A few conversations were held, but the weather was unfavorable, the induction great, and the wires not well adapted to the purpose, so that the experiment was not very satisfactory. The instruments were then attached to short distance lines in the city, and they worked better. Mr. Moore announced that a private wire between Baltimore and Chicago had been in operation for three months, and that it worked very successfully. In case the Brown system is introduced in Milwaukee, the exchange will be built by W. H. Kelsey, the manager of the Postal Telegraph company, and the builder of the original Bell exchange at this point. A great deal of interest is manifested in the project of establishing a competing telephone system in Milwaukee.

John D. McLeod, secretary and general manager of the Wisconsin Telephone company, says that while the expiration of the Bell patents will bring about competition in short distance lines, many important points about the Bell apparatus are protected by patents of comparatively recent date, which will prevent competitors from using the most improved apparatus. The receiver is covered by a patent which will not expire until January 30, 1894. The expiration of Bell's first patent is expected to cause considerable change in the telephone system, and Mr. McLeod intimates that the parent company will either have to protect the state and municipal companies, which pay a royalty, or permit them to meet such competition as they may encounter.

It is possible that an electric railway between Jefferson and Fort Atkinson will be built next summer. The people of Jefferson favor the project.

The telegraph toll between Milwaukee and Superior has been reduced from 40 cents to 25 cents for 10 words.

The Milwaukee & Wauwatosa Motor company has paid the McAlpine right-of-way judgment, which amounted to $22,461 60.

The E. P. Allis company has just completed a temporary power plant for the Milwaukee Street Railway company. It has been erected on a notice of a little more than a month, but it is capable of supplying current for all the cars now operated by the company. The plant is located on Kinnickinnic avenue, on the South Side. It is intended to supply power for the south side lines only. About half the foundry formerly used by the Dutcher Stove company is occupied by the electric plant. In the east end of the building three large engines have been erected, side by side, on raised foundations of brick and stone. They are of the Reynolds-Corliss pattern. One of them is of 600 horse power, another of 500 horse power and the other of 350 horse power. The dynamos are located in the west end of the building. There are six of them, and two are run by each engine. Two of the dynamos are of 200 horse power each, two of 150 horse power and the other two of 100 horse power. The dynamos were made in Schenectady, N. Y. The boilers, six in number, are in a temporary building, 34 by 74 feet in size, with a brick foundation and a frame superstructure. The plant is capable of furnishing power to run from eighty-five to a hundred cars, which is about all that the company operates at present on its entire system, so many cars having been destroyed in the recent fire. The old plant can furnish power sufficient to run all the cars now operated, and the new plant will not be started until more cars are received.

The Superior Electric Belt Line company, with a capital stock of $600,000, has been incorporated. The electric railways of Duluth and Superior will be consolidated and run under one management.

C.

Northwestern Notations.

MINNEAPOLIS, January 21.—A mortgage was filed in the register of deeds' office in this city the other day. It is for a million dollars and is given by the so called "electric combine" to the Minnesota Loan & Trust company. The signers of the instrument are the Minnesota Brush Electric Light company, the Minneapolis General Electric company, and the West Side Power company. The bonds are for $1,000 each, with interest at 6 per cent. Resolutions by the directors assert that the new concern proposes to extend its operations on a large scale.

General Manager Goodrich has intimated that the Street Railway company is figuring to increase materially the speed on the interurban line. This is probably one outcome of the talk of the putting in of electric service on the Northern Pacific road between the cities. Such a line would traverse a route that would permit of a schedule reducing the time fully half what it is now on the interurban electric.

Allusion was made at the time of Villard's recent visit to the Twin Cities of the scheme for utilizing the water power at Taylor's Falls to supply electricity to the cities. It is now reported that Mr. Villard gave up the idea *in toto* as the result of the discovery that the land on both sides of the falls and river for fifteen miles was owned by Isaac Staples, the wealthy lumberman of Stillwater.

Superintendent McMichael, of the Western Union Telegraph company, has a bone to pick with the St. Paul aldermen and he has written an elaborate communication. He complains that the council will neither grant his company permission to put its wires under ground nor allow it to substitute new poles for the rotten ones now above ground.

The St. Paul assembly has passed an ordinance limiting the speed of street cars on down town streets to eight miles per hour, notwithstanding the recommendation of the committee that the limit be made ten miles.

The successor of W. B. Joyce as manager of the St. Paul telephone exchange, has been named. Manager Freedy, of the Fargo, N. D., telephone exchange, is the man. He assumed control of the office on January 1st. Manager Freedy was transferred to Fargo from Stillwater about a year ago. The present manager at Grand Forks will be transferred to Fargo.

The new Minneapolis electric line to St. Louis Park has finally been put in operation with a half-hour schedule.

The Electric & Water company, of Little Falls, Minn., promises its patrons cheaper incandescent lamps in the near future, when the Westinghouse Electric company gets its new lamps on the market.

It is reported that some of the insurance companies have thrown cold water on the project for putting in an electric light plant at Cambridge, Minn., by threatening an increase of rates on buildings where there are electric lights. The men who have the matter in hand don't propose to be frightened, however.

Oakes, N. D., expects to be enjoying electric lights before very long. A franchise is now being sought from the council. C. Gorder is one of the prime movers in the enterprise.

Wallace Harper, of Appleton, Mont., is figuring on putting in an electric plant. He visited Great Falls recently and was greatly pleased with the plant there.

The Minneapolis General Electric company will remove its headquarters from the offices in Washington avenue North to the Windom block, second floor, the spacious quarters formerly occupied by C. A. Pillsbury & Co.

The mayor has signed the amended street railway ordinance, which has caused so much commotion in Minneapolis. The company has not yet signified its acceptance.

A round house, a motor engine and two summer cars belonging to the St. Paul & White Bear Electric Railway company were burned the other night. The loss, about

G. Storey, representing the Beacon Electric Light company of St. Paul, has been figuring at Grand Forks, N. D., in regard to putting plants in the stores.

$10,000, is nearly covered by insurance.

The electric light plant at Granite Falls, Minn., cleared $500 last year.

The organization of an electric light and power company at Cloquet, Minn., is in embryo.

Brainard's electric street railway is about ready to be started up.

The number of subscribers to the telephone exchange at Grand Forks, N. D., has increased the past year from 93 to 190.

The Northwestern Electric Light company has contracted to put in a $12,000 plant at Tracy, Minn., to furnish 40 arc lights and 500 incandescent.

The boilers for the electric light plant at Jamestown, N. D., have arrived.

W. F. Hammond has purchased the electric light plant at Grinnell, Ia. Mr. Hammond is to give the business his entire attention. A local paper says many business men are rejoicing over the prospect of having the plant run in a more business-like way.

The deed has been filed transferring the electric light plant at Austin, Minn., from the Austin Electric company to the Northwestern General Electric company of St. Paul. The consideration was $49,500.

Charles C. Ames, who was killed by falling from a telegraph pole he was repairing on a government line between Port Angels and Cape Flattery, Wash., was the son of ex-Mayor Ames of Minneapolis, and was well known here.

E. S. Corser, the prominent real estate and insurance man of Minneapolis, whose failure has caused so much excitement, has been a leading spirit in the Brush electric light enterprise in this city.

H. C. C.

New England News.

BOSTON, MASS., January 21.—Worcester is about to be made the center of a vast street railway system which will reach out into the country roundabout and control the street transportation interests of the heart of the commonwealth.

The first move was the acquiring by a New Jersey syndicate, known as the Worcester Traction company, of the control of the Consolidated street railway lines. This was the signal for a grand rush for railway franchises in that section. All the lines leading into the city applied for the right to extend their tracks through the principal streets. Then came the report that the Central Massachusetts railroad officials contemplated asking for a franchise for an electric road from Worcester to Marlboro. This stirred up the directors of the Worcester & Shrewsbury Street Railway company, and they hurriedly filed with the selectmen of Marlboro a petition asking for the granting to them of a franchise between the two places. A similar petition was filed with the authorities of Northboro and Shrewsbury. Now comes the new factor in the matter in the shape of a preliminary meeting, held for the purpose of organizing a State Central Railway company which intends to construct a line which will be 43 miles in length, and extend from Worcester through Shrewsbury, Northboro ioto Marlboro, with a branch to the center of Shrewsbury and through Grafton, Northboro and Westboro. Also a line will be constructed from Worcester through Auburn, Leicester, Oxford and Webster. The capital stock is nearly half a million dollars. The projectors are the chief owners of the Spencer and Leicester and Millbury electric roads. It is a big undertaking, and there is a strong fight on hand by all parties for the franchises they ask for. The first hearing will be held January 23rd.

The Postal Telegraph company was burned out of its offices on Devonshire street, Boston, Saturday last. The clerks and the operators left their desks and the electrician had to shut off the electric current on the wires running into the office. All business had to be removed to their Milk street cable office. The damage was more by water than by fire.

Prof. Thompson, of Lynn, in a recent talk on the induction coil said he had been experimenting on high frequency circuits and had been able with currents of high voltage to discharge sparks through five feet of air.

The Lynn & Boston railroad has formally opened its electric line between Lynn and Salem.

The Providence Steam Engine company has built two Green engines for the electric plant of the Pennsylvania railroad at Pittsburg. Each engine will drive two 50-light Thomson-Houston arc and two 600-light Westinghouse alternating dynamos.

J. C. E.

PERSONAL.

C. E. Stump, business manager of the *Street Railway Journal*, is in Chicago.

A. Mitchell Hall, general manager of the C. & C. Electric Motor company, New York, was in Chicago last week.

A. B. Faunce has accepted the position of manager of the Hyde Park Thomson-Houston Light company, Chicago.

C. W. Pike of Philadelphia has been appointed World's Fair representative of Jas. W. Queen & Co. and is now in Chicago.

James H. Dean, well known in electrical circles throughout the West, was married at St. Paul, January 10th, to Miss Adelaide M. Gordon.

W. Worth Bean, president of the St. Joseph & Benton Harbor Electric Railway & Light company of St. Joseph, Mich., was in Chicago last week.

In the last number of the *Technic*, issued by the University of Michigan Engineering society, there appeared an excellent portrait and sketch of Prof. Henry S. Carhart.

Frank S. De Ronde, well known in the electrical trade through his connection with the Standard Paint company of New York, has been appointed general sales agent for that company.

George E. Fisher, general manager of the Commercial Electric company, Detroit, Mich., is enjoying a vacation at St. Augustine, Fla. Mr. Fisher is accompanied by his wife. They report a very pleasant trip.

John Kruesi, superintendent of the Edison factories at Schenectady, was in Chicago last week on business connected with the furnishing of the cable to connect the new West Side and Adams street stations of the Chicago Edison company.

A. G. Waterhouse, of Waterhouse, Gamble & Co., of Hartford, Conn., left on the Servia Saturday last for London, where he will superintend the installation of a large plant for the manufacture of arc lamps. Mr. Waterhouse expects to return about June 1st.

H. R. Canfield, manager of the New England Electrolytic Copper company, Pawtucket, R. I., was in Chicago last week. Mr. Canfield is on his way to Great Falls, Mont., where he will superintend the installation of a large electrolytic plant for the Boston & Montana Copper company.

The Iron Mountain Light & Power company of Iron Mountain, Mich., elected A. A. Young a director of the company and a member of the executive committee on January 20th. Mr. Young has heretofore been superintendent of the company's plant, and his promotion is well deserved.

W. L. Adams, who has been secretary and treasurer of the Railway Equipment company, Chicago, since its formation, has resigned to engage in other business. Mr. Adams has the best wishes of a host of friends in his new undertaking. C. M. Barclay, Chicago, has been selected as Mr. Adams' successor. He is favorably known to the trade, and brings to his new position the advantages of many years of experience in electrical work.

NEW INCORPORATIONS.

Columbus Electric company, Columbus, Kan.; capital stock, $10,000; furnishing electric light.

Susquehanna Valley Electric Traction company, Waverly, N. Y.; capital stock, $20,000; surface street railroad.

Colorado Electric & Gas company, Denver, Colo.; capital stock, $500,000; to manufacture gas and electric light in Arapahoe county.

Westchester & Long Island Tunnel Railroad company; New York, N. Y.; capital stock, $100,000; tunnel railroad to be operated by steam or electricity.

Grand Ridge Electric Light, Power & Creamery company, Grand Ridge, Ill.; capital stock, $6,000; to furnish electric light and power, and run a creamery; C. A. Porter, Grand Ridge, Ill.

Home Electric company, Coudersport, Pa.; capital stock $10,000; supplying light, heat and power by electricity to the public in Coudersport, Pa.; Jas. B. Benson, Coudersport, Pa.

Lancaster & Manheim Railway company, Lancaster, Pa.; capital stock, $250,000; constructing and operating an electric railway in the city of Lancaster; Col. D. B. Case, Mantua, Pa.

The Lancaster & Terre Hill Street Railway company, Lancaster, Pa.; capital stock, $200,000; constructing and operating an electric railway in Lancaster, Pa.; A. B. Bassler, Lancaster, Pa.

Scranton & Pittston Passenger Railway company, Scranton, Pa.; capital stock, $90,000; constructing and operating an electric railway in Scranton, Pa.; Hon. Louis A. Watrous, Scranton, Pa.

Santa Cruz Electric Light & Power company, Santa Cruz, Cal.; capital stock, $300,000; to generate and develop electricity for all purposes and deal in electrical apparatus; Edward Martin, Santa Cruz, Cal.

Charles E. Gregory company, Chicago, Ill.; capital stock, $50,000; to buy, sell, and deal in electrical machinery, supplies and apparatus, and other machinery, etc., Parmly Bros., 625 Home Insurance building, Chicago, Ill.

Grand Street Electric Railway company, Paterson, N. J.; capital stock, $35,000; constructing, maintaining, and operating a street railway for the public use in the conveyance of persons and property, etc.; Jas. A. Morrisse, Paterson, N. J.

Cuero Electric Light, Power & Telephone company, Cuero, Tex.; capital stock, $50,000, to generate and supply electric light and power to the citizens of Cuero and vicinity, and to maintain telephone lines in the city; Otto Staerker, Cuero, Tex.

Patten Electric Power company, Jersey City, N. J.; capital stock, $100,000; to manufacture, build, use, and equip, sell, lease, or otherwise dispose of dynamo electric machines, motors, and all other electrical apparatus, etc.: John Rooney, 145 Broadway, New York, N. Y.

ELECTRIC LIGHTING.

An electric light plant is to be erected in Cleveland, Tenn.

The city of Hillsdale, Mich., will put in its own electric light plant.

A $20,000 electric plant is to be installed at Loreley, Md., by Corthell & Co., of Boston.

The town of Puyallup, Wash., is considering the matter of putting in its own electric light plant.

The Thomson-Houston Electric Light company of Augusta, Ga., will increase its capital stock to $500,000.

The Common Council of Rochester, N. Y., has decided to abandon the use of incandescent lights for street illumination.

It is said that the net earnings of the Edison Illuminating company of New York for 1892 were about $440,000.

The director of public works of Cleveland, O., has been authorized to re-advertise for bids for electric lighting for the year 1893.

The board of public works of Jamestown, N. Y., will issue $15,000 worth of bonds to enlarge the city's electric light plant and extend the system.

The Tiffin O., Electric Light company's works, which included a new plant in process of erection, have been totally destroyed by fire; loss, $30,000.

A special election was held in Augusta, Mo., on January 24th to vote on a proposition to issue $4,000 in bonds for the purpose of putting in an electric light plant.

The electric light plant of Alleghany, Pa., on Braddock street, was damaged by fire on January 8th to the extent of $7,000. The principal damage was done to the dynamos.

An isolated plant having a capacity of 1,600 lamps will be installed in the new Security building at Madison street and Fifth avenue, Chicago. The Chicago Edison company has the contract.

The council of Michigan City, Ind., is considering a proposition to sell its electric light plant to the Lake Cities Electric Railway company, which wants to light the city and operate an electric railway.

The plant of the United States Electric company at Dubuque has been sold to a local syndicate. The price is understood to be $100,000. This is believed to mean the consolidation of all electric light companies in that city.

The management of the Missouri lines of the Burlington has awarded contracts for a system of electric lighting to be used on passenger trains. The St. Louis and Denver trains and the Kansas City and Chicago and the St. Joseph and Chicago flyers will be equipped at once with lights on the storage battery system.

The national light-house board declines to make public the detailed project for lighting St. Mary's river, but it is announced that the appropriation asked for—$150,000—will be sufficient to establish a perfect system of lighted buoys, towers and stands for lights, and to purchase the necessary boats and tugs to keep the lights in operation for one year.

ELECTRIC RAILWAYS.

The Cleveland, O., City Cable company will equip its St. Claire street line with electricity.

The Cass Avenue and Fair Grounds Street Railway company of St. Louis will erect a $15,000 power house.

A petition is being circulated for an extension of the electric railway through Hollis and Queens, N. Y.

The Frankfort, N. Y., Street Railway company has applied to the board of trustees for a franchise for an electric railway.

Electric power is to be used on the Hot Springs, Ark., railway. The line is four miles long and double tracked.

The General Electric company has purchased the Kalamazoo, Mich., street railway at sheriff's sale, and will equip it with electricity.

The Main Street Railway company of Jacksonville, Fla., intends to equip its road electrically, and has already closed the contract.

New York capitalists have been granted a franchise for an electric street railway in Shelbyville, Ind. The road will be constructed at once.

If the bills pending in the Missouri Legislature should pass, over 100 miles of electric street railway will be built, it is said, in and about St. Louis this year.

The Crosstown Street Railway company of Buffalo has increased its capital stock from $1,500,000 to $3,000,000, with a view of adopting the electric system.

The Charleroy, Monongahela City & West Bro[illegible] Electric company, with a capital of $700,000, is being organized at Pittsburg by Jesse Y. Ruggles of West Virginia as the principal promoter. It will build an electric line 50 miles in length up the Monongahela valley to cost $[illegible]000.

The Montgomery, Ala., Terminal & Electric Railroad company has decided to equip its railway with electric power. The board of directors estimates the cost at $125,000, and intends to have work commenced within sixty days. The road is now ten and a half miles long and is to be extended.

A large party of Lynn gentlemen, including members of the city government and the Legislature, attended the opening of the new electric road connecting Lynn and Salem, on invitation of the Lynn and Boston company. A trip over the line was made, and, accompanied by a number of Salem citizens, the party returned at 5 o'clock and dined.

A company is forming at Wilmington, Del., to build an electric line, sixteen miles in length, from Unionville, Chester county, via Centerville and Kennett Square. The West Chester, Pa., Board of Trade looks upon this move as one calculated to direct trade from West Chester to Wilmington, and has projected a line between West Chester and Unionville.

In answer to a query from a Philadelphia newspapers Mayor Curran of Rochester, N. Y., says that the trolley system has given satisfaction in his city. Few accidents have occurred, and the blame for these is to be charged to the carelessness of passengers and motormen. The introduction of the electric system has helped the growth of the city and general business interests. Accidents have resulted, but with ordinary care their number will be very few.

At the anual meeting of the Chicago City Railway company the capital stock was increased from $7,000,000 to $9,000,000. President Wheeler reported that sixteen miles of track had been equipped with electric poles and trolley wires ready for the introduction of electricity. A power house for the electric plant is building at Fifty-second street and Wabash avenue and is about one third completed. All motors and trucks for cars are delivered and mounted and the cars wired. It is expected that the lines on Forty-seventh, Thirty fifth, Sixty-first and Sixty-third streets will be running by May 1st. Application has been made to the council for the right to construct electric lines to a total of seventy-five miles.

During 1893 the Southern Pacific company of San Francisco will build over twenty miles of rapid transit lines, fifteen miles of this being electric and five miles cable road. Material for the entire system has been ordered, and as fast as it arrives it will be put in place. The Kentucky street electric road, now being built, begins at Fourth and Townsend streets, and will run out Kentucky street to Railroad avenue, and out Railroad avenue to South San Francisco, covering a distance of about three miles. Still more important is the Mission street road, to be built from East and Mission streets, on the water front, out Mission street and Mission road to the county line, a distance of eight miles. Work on this line, which will also be on the electric system, will be begun about January 1st and pushed forward to completion as fast as possible. It is thought that the road will be ready to handle traffic by the beginning of July. While these two roads are being built, construction work will be begun on two connecting lines, which will tap the most populous district south of Market street. One of these will run from the junction of Solano and Kentucky streets to Sixteenth and Mission, where it will connect with the main line. The other will start at Center avenue, and run down Kansas street to Brannan, down Brannan to Sixth, and down Sixth to Mission. Power for this extensive system will be generated at one central point, and from there distributed over all the lines. The exact site for this power house has not yet been definitely fixed upon but will probably be as near the center of the system as practicable. The plant will be one of the largest of its kind in the United States.

TELEPHONE.

The Missouri & Kansas Telephone company has opened offices at Rosendale, Bolckow, Barnard and Maryville, Mo.

At the annual meeting of the Central Union Telephone company it was reported that the net earnings for the year were $380,307 and that the number of subscribers was 24,600.

A new telephone line will be completed in a few months from Portland to Spokane, a distance of 450 miles. The line will be a double wire circuit, and the poles will have cross arms and capacity for six other wires. The line will cost $100,000.

MISCELLANEOUS.

The General Electric company of New York sent a check for $1,000 toward the Press club building fund of that city last week.

President Adams, of the University of Wisconsin, presented a report on the needs of that institution at a special meeting of the regents January 4th. In the course of his remarks he said, referring to the college of mechanics and engineering: "The capacity can be very nearly doubled without very large expense. The north wing should be extended during the coming summer about fifty feet, and the whole wing should be made two stories high. This would enable the rapidly growing department of electrical engineering to make adequate provision for the apparatus required by gift and purchase."

TRADE NEWS.

The Redding Electric company, Boston, received eighteen orders in one day for its new watchman's register.

I. B. Davis & Son of Hartford, manufacturers of the Berryman heaters, are busy making their orders for February.

The Elektron Manufacturing company of Springfield, Mass., is making a specialty of its new controller for elevator work, which it reports has given satisfaction.

The Vulcanized Fibre company, of New York, was awarded the silver medal for its fine exhibit of vulcanized fibre goods, at the Crystal Palace exhibition, London. This company is very busy with orders for fiber goods.

E. R. Rand, general manager of the Newton Rubber company, Boston, reports an unusual amount of rubber work for electrical purposes. The company will have special facilities for the quick delivery of orders during this year.

Treasurer H. G. Pratt, of the Samson Cordage Works of Boston, says that he is very much gratified at the large number of orders which are being received for future delivery at this time of the year, when the business is usually quiet.

C. C. Allen, general manager of the Boston Electric Manufacturing company, recently returned from an extended trip through the West. The large number of order, with which he was favored indicates that his trip was not all for pleasure.

General Agent L. E. Bellows of the Dean Steam Pump company of Holyoke, Mass., reports that the company is making arrangements for several large installations in the West. During the year this concern has been placing large numbers of pumps for mining work. Its large factory has been severely taxed to meet increase in trade.

Waterhouse, Gamble & Co., of Hartford, have received a testimonial letter from G. W. Phillips, superintendent of the Norwich Electric Light company, regarding several tests of their arc lamp, in which it is said that it burned 14 hours and 15 minutes on a $\frac{5}{8}$ inch plain carbon. The company is making a special feature of carbons in connection with its lamps.

The Jewell Belting company, of Hartford, Conn., is sending out a handsome catalogue, bound in pebbled leather, entitled "Transmission of Power by Leather Belting," which contains directions for the lacing, care and use of leather belting. It also contains illustrated descriptions of the company's staple goods and specialties. It is a compact and valuable little book.

The W. S. Edwards Manufacturing company of Chicago, manufacturer of gas and electric light fixtures, is remodeling the five-story and basement building at 21 and 23 Lake street, and will remove its offices and factory into these quarters on or about March 1st. As the new plant will contain nearly two acres of floor space, the company will have ample room to care for its increasing trade.

The Fibrone Terraloid company of Newark, N. J., is manufacturing a substitute for hard rubber recently introduced on the market in a material under the name of fibrone. This material is adapted to use in electrical fittings, as it is a non-conductor of electricity and an exact imitation, in appearance, of hard rubber. Among the electrical articles in which it can be used may be mentioned lamp keys, telegraph instrument handles, switch keys, battery jar covers and push button centers.

The annual meeting of the stockholders of the Railway Equipment company, Chicago, was held on Tuesday, January 17th, and the report of General Manager W. R. Mason showed a most satisfactory state of affairs. The business of the company has been very greatly in excess of expectations, and is daily increasing. Mr. Mason called attention to the need of further increasing the manufacturing facilities. It is announced that a prominent capitalist has become interested in the company with the intention of still further increasing the business of that company.

The Electric Appliance company, Chicago, will continue to represent the Emerson Electric Manufacturing company of St. Louis as special western selling agents for the Meston motor. The Electric Appliance company last summer installed several hundred of these machines. Preparations have been made this season to anticipate any possible demand, and a large number of machines have already been sold for delivery May 1st. It is rather cold business exploiting fan motors under the present atmospheric conditions, but the Electric Appliance company has already booked a number of handsome orders and closed many of their sub-agency deals.

BUSINESS.

The Parton Motor Manufacturing company, Chicago, has increased its capital stock to $1,000,000.

The Jewell Belting company, of Hartford, Conn., is rushed with orders for leather belts. The business for December breaks all previous records, being the largest since the organization of the company.

Chas. E. Bibber, of the Consolidated Electric Manufacturing company, of Boston, is presenting his many friends with a little counter for playing cards, on which he also reminds them that the company still has for sale the Bibber arc lamp and Consolidated arc dynamos. On the back is a cut of the Lyon brake handle.

The Southern Electrical Supply company, St. Louis, has found it necessary, on account of its rapidly increasing business, to secure new quarters. It has removed to 11 North Seventh street, where it has secured much larger quarters and better conveniences for handling its goods. The company is receiving congratulations upon the success which it has enjoyed.

The Standard Oil Company has issued a small pamphlet on lubricating oils and greases, which contains many points of interest to central station men. The company is making a specialty of Capitol cylinder oil for steam valves, Renown engine oil for electrical machinery and Atlantic red oil for all parts of engines except cylinders.

Queen & Co., Philadelphia, are congratulating themselves upon the increasing demand for their magnetic vane ammeters and voltmeters, as evidenced by the fact that more than twice as many of these instruments were sold by them in 1892 as in the preceding year. The instruments are adapted for constant switch-board use, and voltmeters, as well as ammeters, can be left in circuit constantly. A number of prominent dynamo building companies have adopted this type to install with isolated plants for incandescent lighting and for power circuits.

The Pioneer Armature Works, room 415, 195 Canal street, Chicago, is well equipped for electrical repairing work of all kinds. This firm has a number of competent armature winders at work, and makes a specialty of rewinding dynamo and motor fields and armatures. In addition to this it also undertakes repair work on commutators, returning and refiling and putting them in thorough running order. The manager of the Pioneer Works is Chas. A. Phillips, a practical electrical engineer. From present indications it would seem that this concern is likely to secure a good share of business in Chicago and Cook county, as well as from points farther away.

The Heinze Electric company, of Lynn, Mass., is busy filling orders for its dead beat volt and ampere meters which are very sensitive to current variations and accurately calibrated, measuring both direct and alternating currents. The company is also filling a number of large orders for automatic fuse cut-outs for railway and arc circuits. This company makes a special feature of Wimshurst influence machines. This machine, with 16 inch glass plates, is mounted in hard rubber casing on an ebonized base, with small Leyden jars, giving a 7 inch spark.

The Westinghouse Electric & Manufacturing company has issued an interesting circular concerning the capacity of its factories. The company has three factories in operation; one on Garrison alley, Pittsburg; a second (the old air brake works) in Allegheny, and the third in Newark, N. J. There are employed to-day 2,615 operatives in Pittsburg and Allegheny, and 485 in Newark. The present output of all of these factories aggregates $575,000 per month, and this can, with present facilities, be increased to about $800,000 per month to meet demands. The machinery now erected is sufficient in size to make generators of 5,000 horse power capacity, such as are now wanted by the Niagara Cataract Construction company. There are now 604 central lighting stations, 2,300 isolated lighting plants and 200 electric street railways using the company's apparatus; and among the railways are those operating in New York, Philadelphia, Brooklyn, Chicago, St. Louis, Cincinnati, Cleveland, Pittsburg, Rochester and Albany. The company can now readily turn out 200 motors each week, or sufficient for 5,000 cars per annum, each car usually having two motors for its operation.

It will doubtless be news to many to learn that Charlee H. Wilson, so long identified with the Chicago Telephone company as its general superintendent, has severed his connection with that company in order to go into business for himself. Mr. Wilson has formed a co-partnership with George W. Jackson, a prominent and well-known Chicago contractor, and will immediately engage in general construction work. The new firm will undertake contracts for all kinds of street and highway work, making a specialty of construction work for electrical companies. It will do a general contracting business in the line of electric railway construction, telephonic and telegraphic, aerial and underground work, and in fact build any sort of electrical sub-way, conduit or tunnels. The new firm is already in position to handle contracts for all sorts of masonry work and aerial line construction. With two such experienced men at the head the new concern will undoubtedly constitute a strong team. Mr. Jackson has been in the contracting business for fifteen years, and has constructed a large amount of underground work in Chicago, not only for the telephone and telegraph companies, but also for the electric light companies. He has also built some of the larger Chicago sewers. Mr. Wilson's record is already well known to the electrical fraternity. From 1876 to 1881 he was assistant electrician for the Western Union Telegraph company; from 1881 to 1888 he held the position of general superintendent for the Central Union Telephone company, and also had under his control the other companies which had been absorbed by the Central Union company. From 1888 up to a short time ago Mr. Wilson was, as is well known, general superintendent of the Chicago Telephone company. While in this latter capacity he was actively engaged in construction work, and also acted as consulting engineer in other lines of electrical work. Readers of the WESTERN ELECTRICIAN will remember that Mr. Wilson devised and engineered the laying of the virtrified clay or terra cotta conduit system which is now in use in Chicago. No better example than this work, representing as it does an investment of many thousand dollars, could be found to illustrate the capabilities of the new firm. The new concern starts out under most favorable circumstances. With Messrs. Wilson and Jackson at the head, and with the large amount of business already in hand it seems most reasonable to presume that it will not only continue to command its share of business in the West, but also work itself into the foremost ranks of western contractors. Messrs. Wilson and Jackson have taken offices at 31 Times building, Chicago.

ELECTRICAL PATENTS.

Issued January 17, 1893.

489,938. Electric Battery. John H. Davis, Detroit Mich.

489,944. Electric Railway Switch. August C. Goetz, Milwaukee, Wis.

489,972. Electric Car Brake. Andrew C. Miller, Auburn, N. Y.

489,983. Electric Cut Out. William B. Potter, Lynn, Mass.

489,990. Telephone. Charles E. Scribner, Chicago, Ill.

Deflecting surfaces are provided, which are placed at such an angle with respect to the diaphragm as to afford sufficient impact surfaces so that the carbon will be properly compressed to change or vary its resistance in response to the vibrations of the diaphragm, yet so arranged that the particles of carbon striking against these surfaces will be deflected and caused to circulate, thus serving to prevent packing of the carbon.

490,011. Electric Meter. Fernando J. Dibble, Peabody, Mass.

490,012. Electric Telemeter Transmitter. Fernando J. Dibble, Peabody, Mass.

490,013. Electric Telemeter Transmitter. Fernando J. Dibble, Peabody, Mass.

490,014. Electric Telemeter System. Fernando J. Dibble, Peabody, Mass.

490,028. Trolley. John C. Love, Chicago, Ill.

Two levers are journaled upon the end of a supporting bar adapted to swing in a vertical plane, and provided with a spring tending to throw the bar upward. Upon the ends of the two levers are mounted the trolley wheels, each lever being independently acted upon by a spring to press the trolley wheel yieldingly against the trolley wire.

490,034. Electric Heater. Thomas E. Morford, Minneapolis, Minn.

The heater comprises a metallic plate adapted to be heated, and to conduct the heat to the articles to be operated upon, and a coating of enamel applied to the face of the conducting plate in which is embedded the conducting wire. In applying the enamel to the plate a first layer is spread upon the plate upon which is coiled the conducting wire, after which a second layer of the enamel is spread upon the first, which, upon the application of heat, adheres to the first layer, thus leaving the conducting wires embedded.

The first claim reads:

"In an electro-heating apparatus the combination with the heated surface plate and the resistance of a coating of enamel or its equivalent securing the resistance to, but insulating it from said plate."

490,064. Telegraphy and Telephony. Fred. H. Brown, Chicago, Ill.

The invention embodies means for utilizing the same circuit for telephonic and telegraphic purposes, and comprises a normally closed electric circuit in which is placed a diaphragm, against which rests a contact point carried upon a lever which holds the contact point in mechanical and electrical contact with the diaphragm. When it is desired to transmit a telegraphic message over the circuit the lever is raised out of contact with the diaphragm.

490,081. Commutator Brush and Holder. James F. McLaughlin, Philadelphia, Pa.

490,082. Electric Heater. James F. McLaughlin, Philadelphia, Pa.

The heater comprises a flat strip of metal of high electrical resistance bent into sinuous loops, and embedded in fire clay. The conductor having been placed in the clay, the clay is baked in the ordinary manner; and, in order to exclude the air from the heating conductor and moisture from the embedding material, a coating of glazing or enamel is provided upon the clay. This enamel exterior may be made ornamental by designs in colors, and the heater requires no exterior mantle of iron.

490,161. Electric Alarm Lock. Joseph A. Nadeau, Detroit, Mich.

490,178. Electric Circuit Breaker. Elihu Thomson, Swampscott, Mass.

The circuit breaker is designed to prevent the arcing and consequent destruction of electric switches adapted to carry currents of large volume, in which the switch blade closes between pairs of contact fingers connected in multiple with the circuit. In this form of switch, due to unavoidable inaccuracies in the workmanship, there are generally one or two pairs of contact fingers that break connection with the switch blade last, and consequently the entire current passes through these contact fingers. An inductive resistance is placed in circuit between each pair of contact fingers and the main conductors, and as the pairs of contact fingers successively break contact with the blade, thus lessening the number of paths for the current, the currents through the remaining contact fingers tend to increase, but the effect of the increase of current upon the inductive resistances is to create a counter electromotive force which counteracts the increase of current, permitting only the normal currents to pass through the contact fingers last, breaking contact with the switch blade.

490,183. Commutator Brush. Carl O. C. Billberg, Philadelphia, Pa.

The brush is designed to overcome the difficulty caused by the cutting of the commutator, due to the oxidization of the copper when a spark is formed, producing globules of copper oxide which are harder than copper itself. The brush is made of copper on the front or entering side or edge, with carbon, plumbago or equivalent material applied to the back or leaving side or edge. When a spark occurs the carbon is oxidized instead of the copper, resulting in carbon dioxide, a gas, so that the bearing surface of the brush remains smooth.

490,202. Mechanism for Testing Watch Balances and Hair Springs. George E. Hunter, Elgin, Ill.

490,203. Method of Testing Watch Balances and Hair Springs. George E. Hunter, Elgin, Ill.

490,211. Automatic Releasing Device. Hans P. Nielsen, Alameda, Cal.

490,231. Galvanic Battery. Noah M. Powell, Galesburg, Ill.

490,248. Electric Railway System. Thomas Harris, Detroit, Mich.

490,256. Electrically Heated Soldering Iron. George R. Meitzler, Cincinnati, O.

Eugene F. Phillips, Prest. W. A. Hathaway, Treas. W. H. Sawyer, Sec'y.

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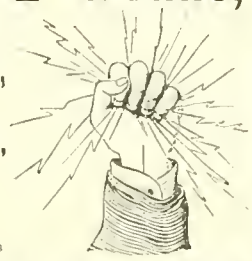

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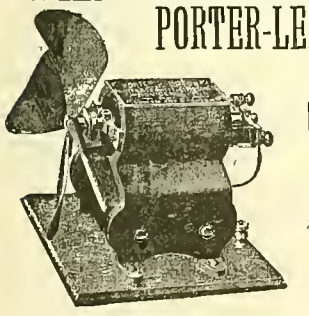

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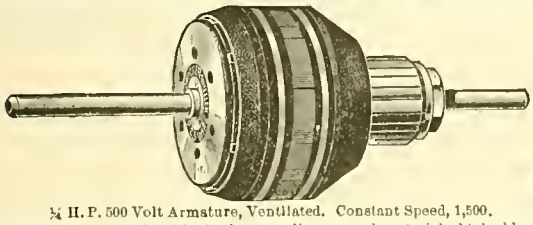

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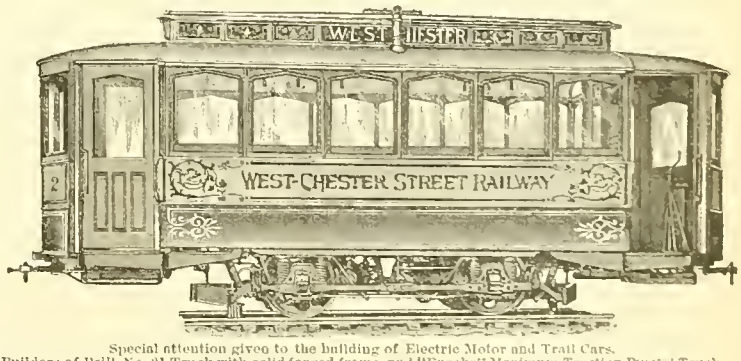

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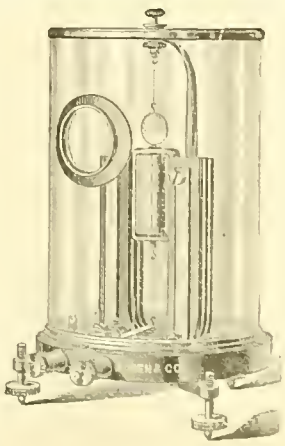

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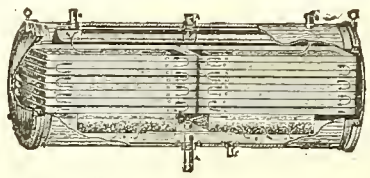

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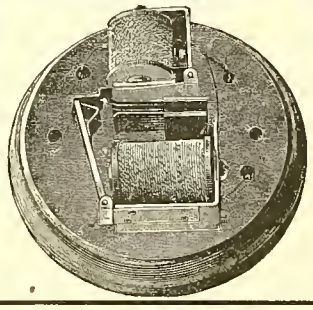

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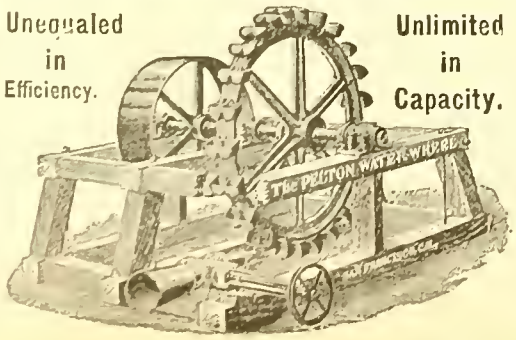

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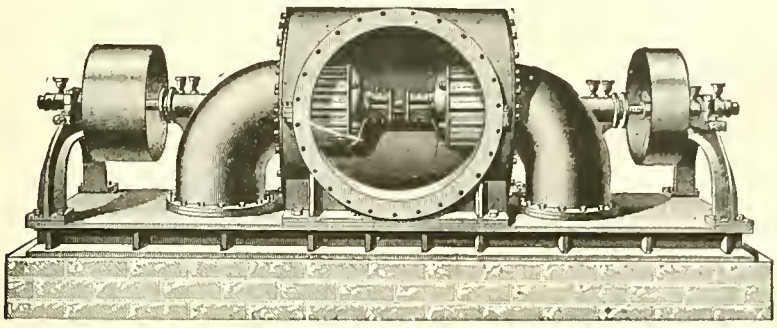

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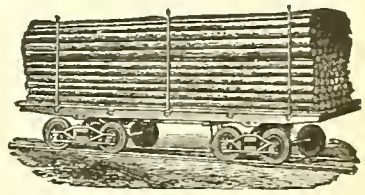

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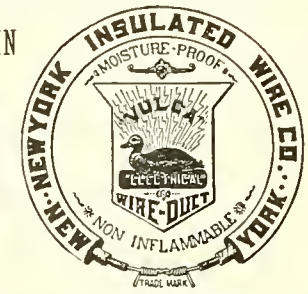

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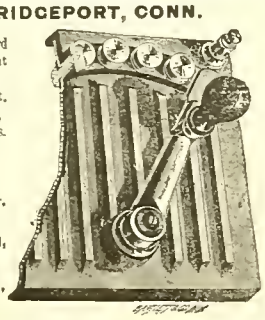

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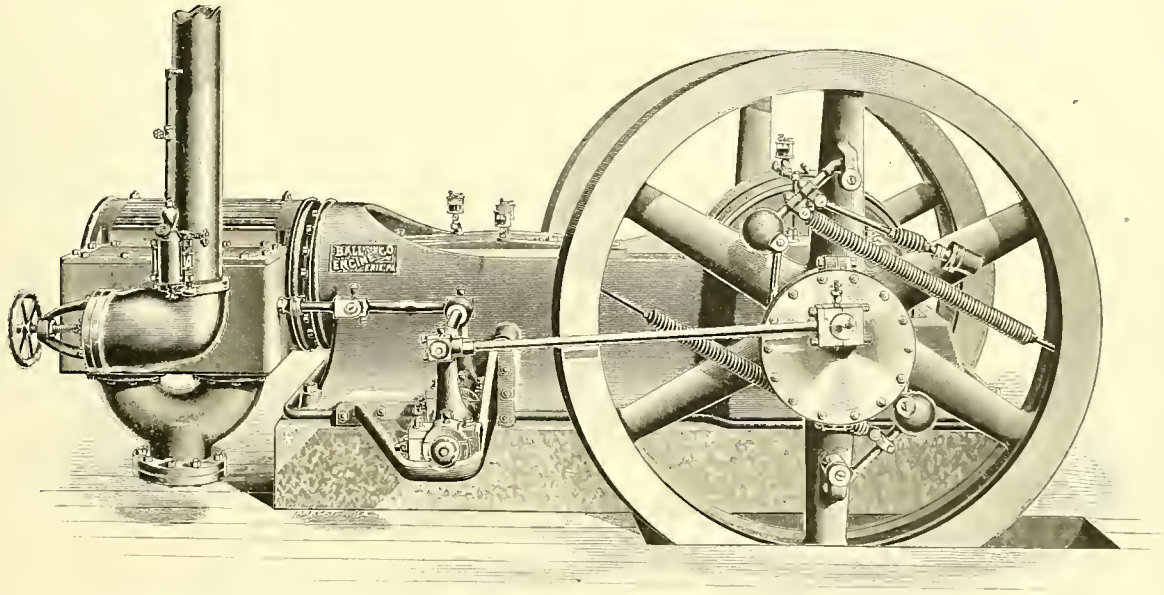

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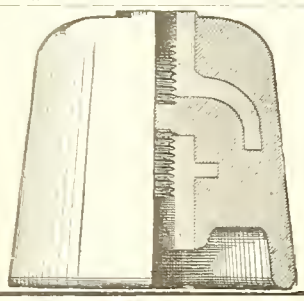

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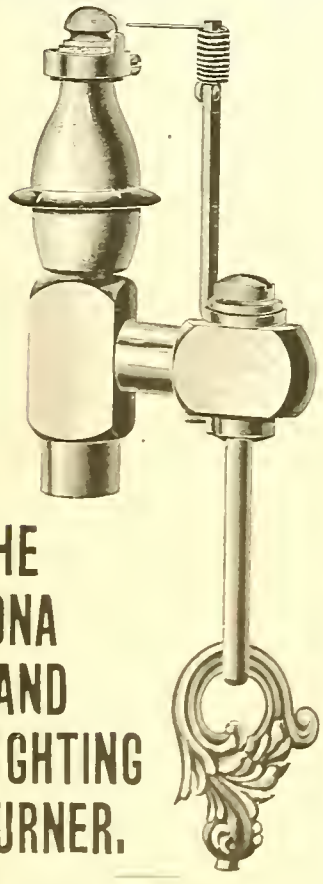

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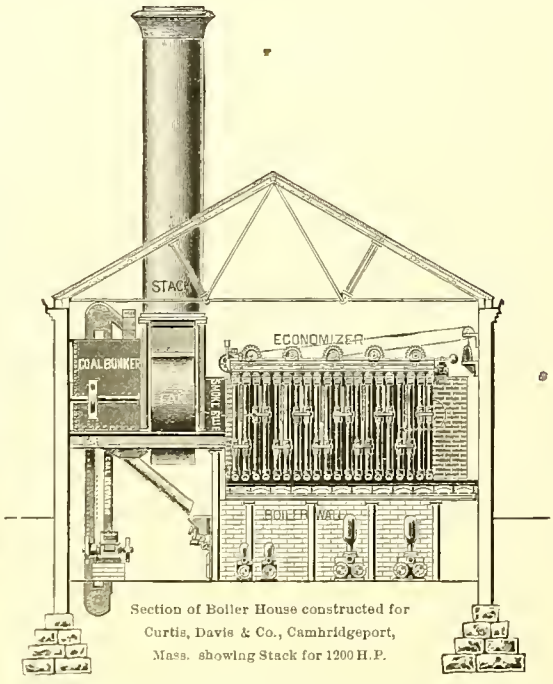

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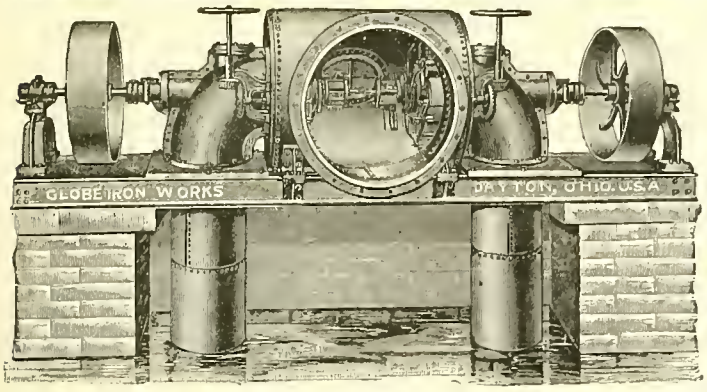

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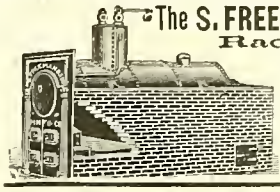

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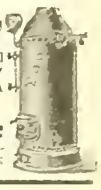

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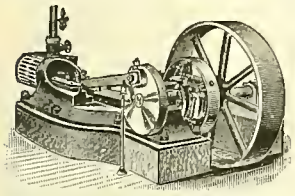

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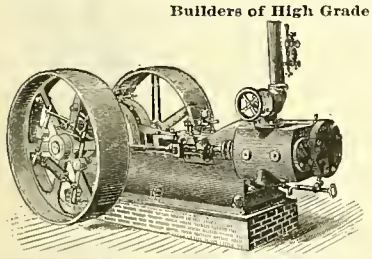

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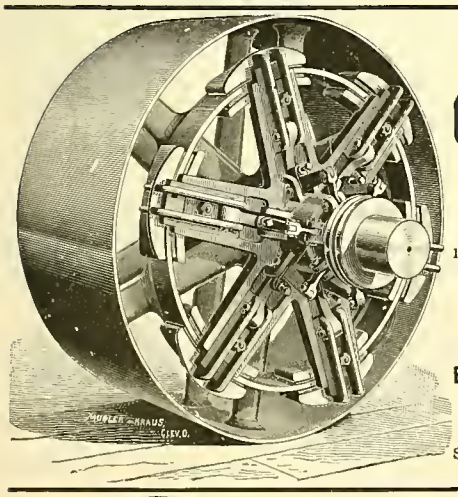

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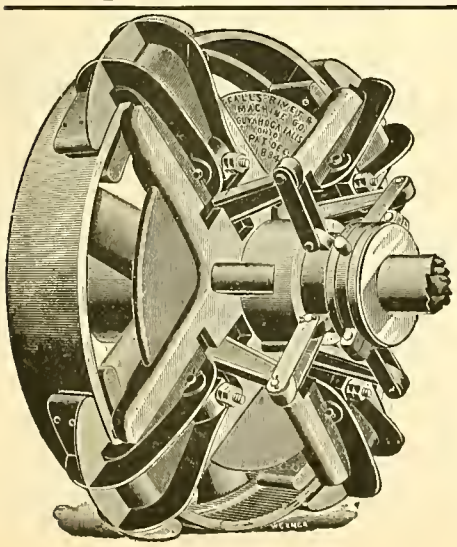

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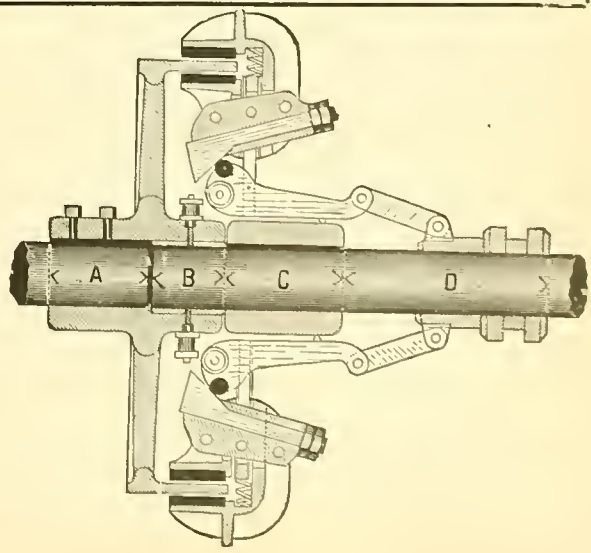

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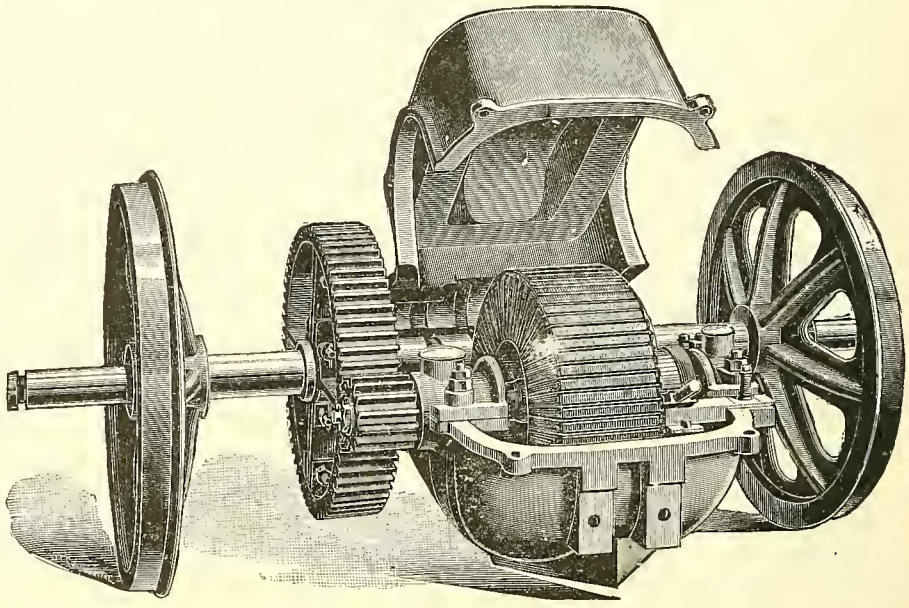

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Comprises All the Latest and Most Improved Street Railway Appliances.

Street Railway Snow Sweepers

Should be Ordered from us at Once.

We are the Only Company who can Supply Reliable Snow Sweepers.

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44 Broad St., NEW YORK.
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401-407 Sibley St., ST. PAUL, MINN.
Gould Building, ATLANTA, GA.
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15 First Street, SAN FRANCISCO, CAL.

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THE KNAPP ELECTRICAL WORKS,

54 and 56 FRANKLIN STREET, CHICAGO.

Your order is promptly and carefully taken care of by one of them.

FUSE WIRE
AND
FUSE LINKS.

Our reliable Fuse Links are "one piece" and will not get loose under binding screws.

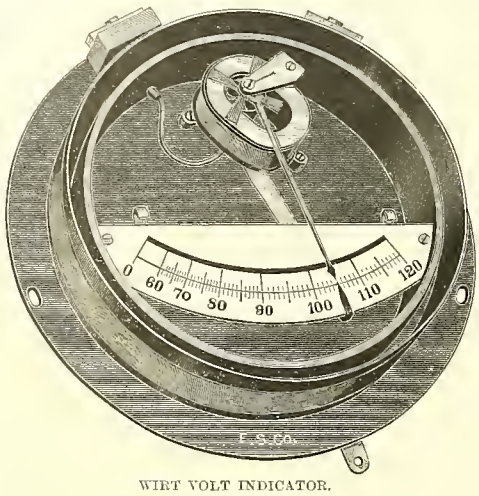
The Stanley Transformers

Are already so well and favorably known that we are at a loss to say anything that will add to the brilliant record which they made for themselves during the past year.

SHIELD BRAND
MOISTURE-PROOF WIRE.

For Feeder Circuits.
For Light and Power Lines.

Are you using the Wirt Commutator Brushes?



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(INTERIOR VIEW.)

THE WIRT ELECTRIC INDICATORS.

Made with Moisture, Dust and Time Proof Cases.

These instruments are designed to meet the severest conditions of exacting commercial practice in station work.

These instruments have been adopted as a standard by the largest station operators in the United States.

We guarantee their Accuracy and Reliability.

Habirshaw's Pure Rubber Covered Wires, Cables and Cores.

The U. S. Government Standard of Excellence.

Carpenter Electric Heating Apparatus.

Car Heaters.

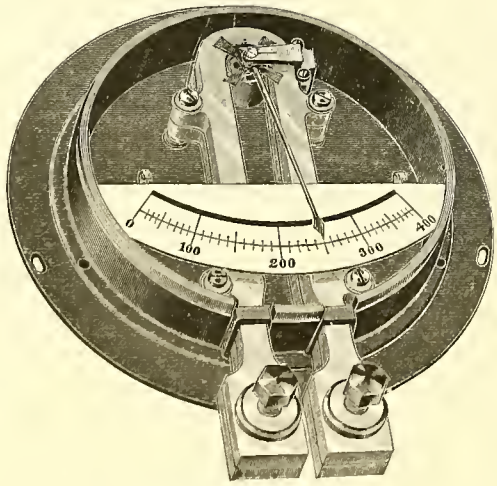
Radiators for Offices and Residences.

Cooking Utensils.

If you are running with inferior Indicators, or, worse still, with none, don't let another week pass without ordering.

Do it To-Day!

DO IT NOW!



WIRT AMPERE INDICATOR.
(INTERIOR VIEW.)

STEEL WIRE
TRACK BROOMS.

A clean rail makes it easy for the motor or the motor.

The Electrical Supply Co.,

Corner Randolph Street and Michigan Avenue,

Factories and Eastern Offices:
ANSONIA, CONN.

CHICAGO.

CATALOGUES:

Electric Light and Power, No. 23.

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Electrical House Goods, No. 44A.

We carry a large stock of *accurately* drawn and insulated

MAGNET WIRES.

Orders for quick shipments solicited.

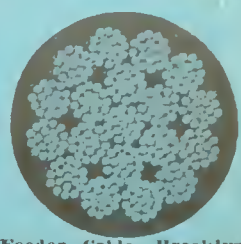
THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.

THE RUBBER USED IN

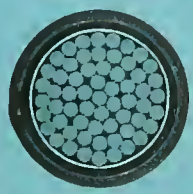
HABIRSHAW INSULATION

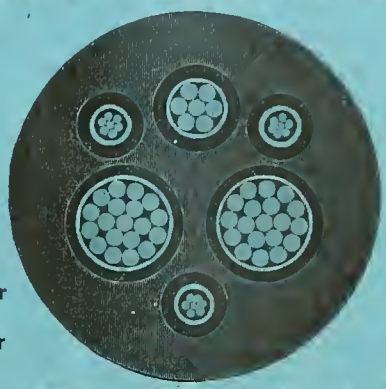
IS PURE PARA.

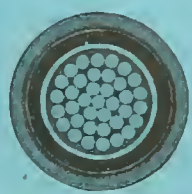
Underground Core.


Feeder Cable, Brooklyn Edison Electric Light Co.

Underground Core, N. J. Central R. R.


Feeder Core, Broadway Theater.


Submarine Work, Edison Electric Light Co., Easton, Pa.


Naval Core, United States S. S. "Chicago."

Portable Cable, Broadway Theater.

Marine Core, used on Government Cruisers.

Naval Marine India Rubber Covered Wires.
Naval Land India Rubber Covered Wires.

PROMINENT INSTALLATIONS.

STANDARD INDIA RUBBER COVERED WIRES.

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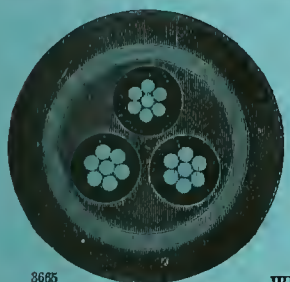
Adopted by the Navy Department, and thus far employed on board the United States steamships Trenton, Chicago, Boston, Yorktown, Pensacola, Philadelphia, Petrel, Atlanta, Baltimore, Newark, Vermont, Charleston, San Francisco, Concord, Bennington and monitor Miantonomah.

SOLID AND STRANDED CONDUCTORS, TAPED, BRAIDED, FLAME-PROOF.

The Habirshaw Insulation fulfills all requirements in places demanding the "Best," and in that field finds no successful competitors.

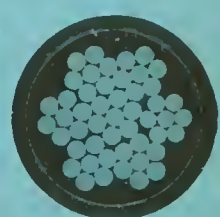

3665 Feeder Core.

FACTORY: GLENWOOD, YONKERS, N. Y.

WM. M. HABIRSHAW, F.C.S., GENERAL MANAGER.

OFFICE: 315 Madison Ave., Cor. Forty-Second St., NEW YORK CITY.

WESTERN AGENTS: THE ELECTRICAL SUPPLY CO., cor. Randolph St. and Michigan Ave., CHICAGO, ILL.


Feeder Cable, Brooklyn Edison Electric Light Co.

74 Transformers

Struck by lightning during the past Summer

In One Town,

40 were Stanley——**34** were of another prominent make.

What was the result?

1 STANLEY ONLY WAS BURNT OUT,
39 SIMPLY HAD THEIR FUSES BLOWN.
15 OF THE OTHER MAKE WERE BURNT OUT.

We will send full particulars, name of town, etc., to any purchaser who wishes to know the facts, or corroborate this statement.

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Pittsfield, Mass.

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TIMES BUILDING, CHICAGO.

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Satisfaction is guaranteed in all work we undertake to perform.

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PITTSBURGH, PA.,

MANUFACTURERS OF APPARATUS FOR

Arc Lighting, Incandescent Lighting,

LONG DISTANCE TRANSMISSION OF POWER,

Street Railway Generators, Motors and Appliances.

Our alternating current incandescent apparatus is in use in 430 central stations. 1,000 isolated plants. Our arc apparatus is in use all over the world.

We are now transmitting light and power various distances up to 28 miles from the source.

Our multipolar railway generators and noiseless single reduction motors have worked a revolution in the electric railway field in two years.

Orders for APPARATUS, REPAIRS and SUPPLIES formerly furnished by the United States Electric Lighting Co., Newark, N. J., should now be sent to this Company, where they will receive prompt attention.

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AGENTS FOR CANADA: AHERN & SOPER, OTTAWA, ONT.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. XII. CHICAGO, FEBRUARY 4, 1893. No. 5

EVERY STEAM, ELECTRIC LIGHT AND POWER PLANT

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Bristols' Recording Pressure Gauge.

Makes continuous record day and night. Adapted to all ranges of pressure between 2 oz. per square inch to 1,500 lbs. per square inch.

PRICE LOW, AND EVERY GAUGE GUARANTEED.

Send for Circulars and Fac-Simile Chart.

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PACKARD HIGH GRADE INCANDESCENT LAMPS.

Manufactured by the

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Omaha, Neb., B. B. Dowse, 215 Sheely Block
St Louis, Mo., St Louis Electrical Supply Co.
San Francisco, Cal., A. C. Brainard & Son, No. 109 California St.
Cincinnati, O., Post-Glover Elec. Co., 215 W. 4th St.
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Pittsburgh, Pa., W. H. Vandevort, 709 Lewis Block.
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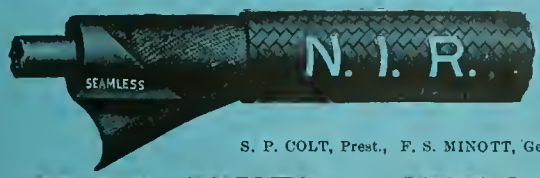
Little Rock, Ark., Arkansas Electric Supply Co., 307 W. Markham St.
Montreal, Can., Packard Lamp Co., 96-100 King St.

NATIONAL INDIA RUBBER CO.



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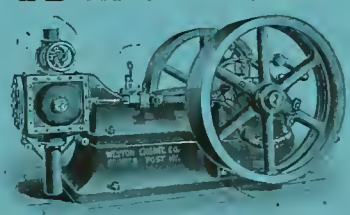

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COMPLETE POWER PLANTS.

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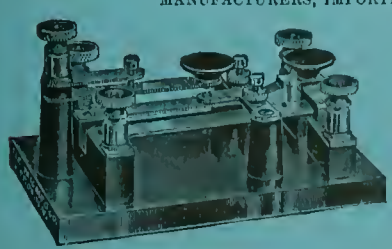

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OF ALL DESCRIPTIONS.

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WHERE WE MANUFACTURE A FULL LINE OF

Test Instruments and all Scientific Measurement Apparatus.

THE BALL & WOOD COMPANY,

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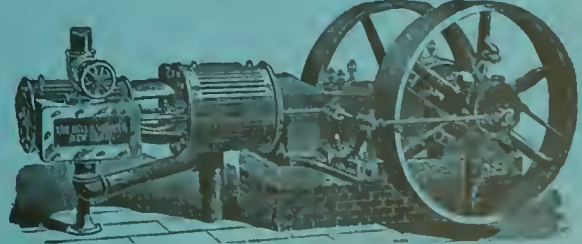

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W. B. Pearson & Co., Home Ins. Bldg., Chicago Ill.
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James A. Co., Chattanooga, Tenn
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TO AN INJUNCTION AGAINST INFRINGERS
HAS BEEN DETERMINED
BY THE
U. S. CIRCUIT COURT OF APPEALS.

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Is the ONLY INCANDESCENT LAMP lawfully made.

ALL OTHERS INFRINGE THE EDISON PATENTS AND ARE COUNTERFEITS.

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See decision of U. S. Circuit Court of Appeals in case of Edison Electric Light Co. and Edison General Electric Co., against Sawyer-Man Electric Co., decided December 15, 1892.

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Ostrander & Co., W. R.
Partrick & Carter Co.

Arc Lamps.
Beggs, J. E., Mchy. & Supply Co.
Duplex Electric Co., Ltd.
Electric Cons. & Supply Co.
General Electric Co.
Knapp Electrical Works.
Rose Electric Light Supply Co.
Siemens & Halske Electric Co.
Standard Electric Co.
Waterhouse, Gamble & Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Knapp Electrical Works.
Samson Cordage Works.

Batteries.
American Battery Co.
Columbia Mfg. & Supply Co.
Electrical Supply Co., The.
Ford Washburn Storelectro Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Leclanche Battery Co., The.
Partrick & Carter Co.
Western Electric Co.

Battery Jars.
American Battery Co.
Bu ler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Leclaunche Battery Co., The.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Chicago Rawhide Mfg. Co.
Jewell Belting Co.
Page Belting Co.
Shultz Belting Co.

Boilers.
Babcock & Wilcox Co., The.
Blanchard, Albert.
Freeman Sons Mfg. Co., The S.
Lane & Bodley Co., The.
N. Y. Safety Steam Power Co.
Weston Engine Co.

Books, Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electric Appliance Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.

Cables.
(See Insulated Wires.)

Cables, Electric. (See Insulated Wires), **Copper, Sheet and Bar**
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Eastern Electric Cable Co.
Moore, Alfred F.
Roebling's Sons Co., J. A.
Washburn & Moen Mfg. Co.
Western Electric Co.

Carbons, Points and Plates.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.

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Falls Rivet & Machine Co.
Hill Clutch Works.
Lake, J. H. & D. Co.

Cordage.
Samson Cordage Works.

Construction and Repairs.
Comstock, Louis K.
Electric Cons. & Supply Co.
Western Electric Co.
Wilson & Jackson.

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American Engine Co.
Babcock & Wilcox Co., The.
Ball Engine Co.
Ball & Wood Co., The.
Brush Electric Co.
Cabell, L. Breckinridge.
Comstock, Louis K.
Diamond Electric Mfg. Co.
Ford-Washburn Storelectro Co.
Freeman Sons Mfg. Co., The S.
General Electric Co.
Great Western Electric Supply Co.
Hatheway, E. M.
Heisler Electric Co.
Lake Erie Engineering Works.
Lane & Bodley Co., The.
La Roche Electric Works.
Lefmann, Julius.
Morse & Co., A. M.
N. Y. Safety Steam Power Co.
Osborne Steam Engineering Co.
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Siemens & Halske Electric Co.
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Copper Wires and Tapes.
American Electrical Works.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
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Enterprise Electric Co.
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Knapp Electrical Works.
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National India Rubber Co.
Roebling's Son's Co., J. A.
Sperry Elec. Mining Machine Co.
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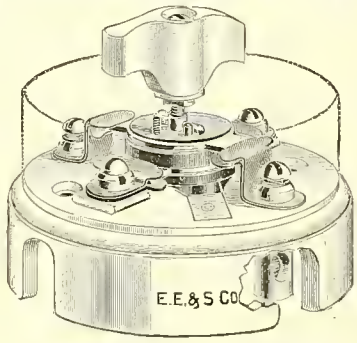

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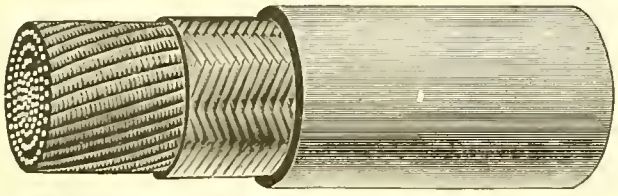

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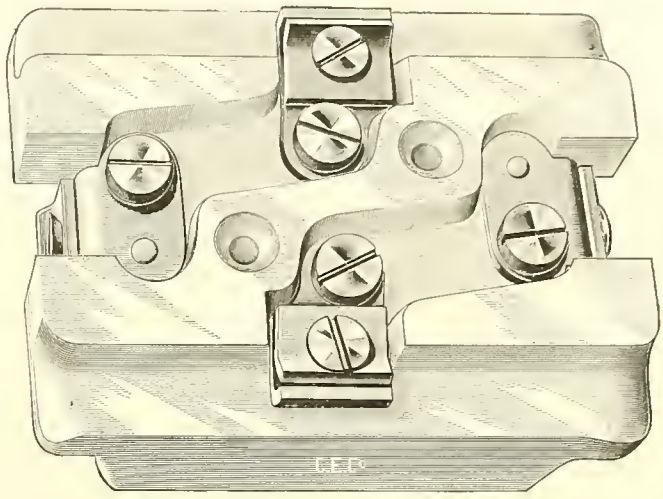

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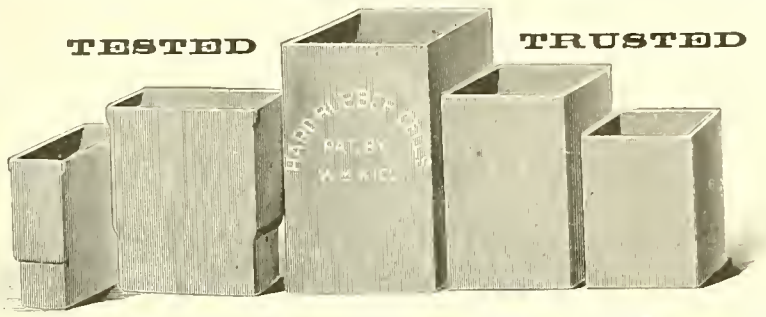

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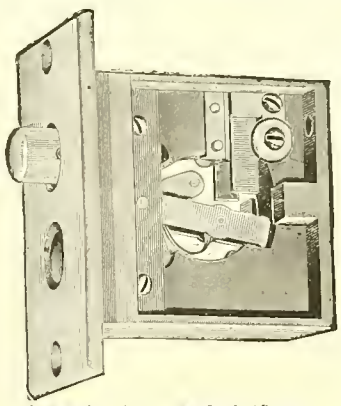
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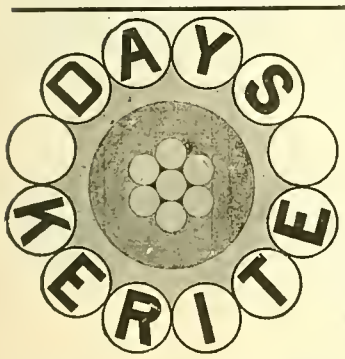

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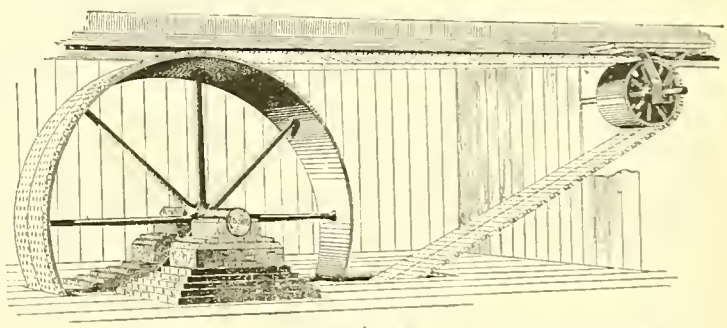

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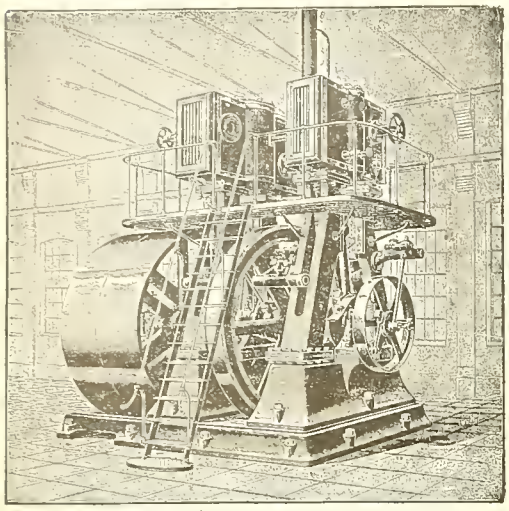

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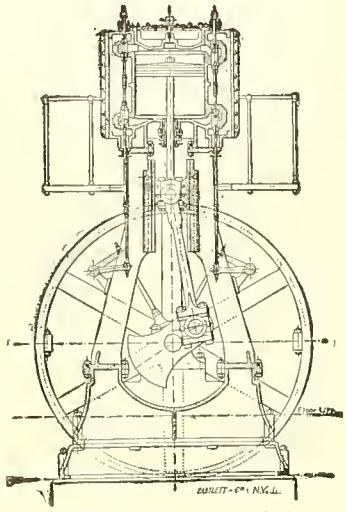

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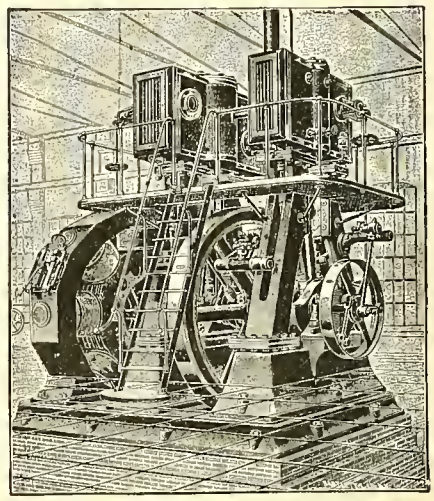

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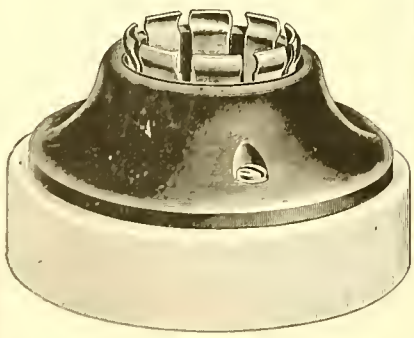

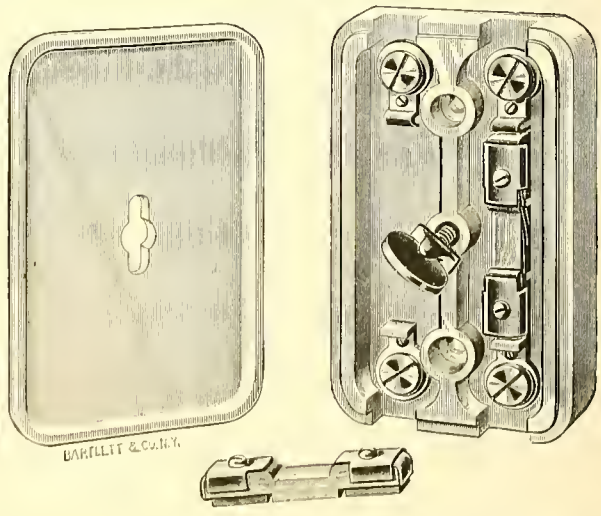

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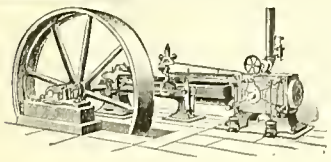

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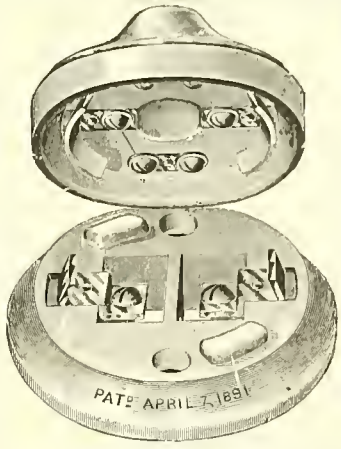

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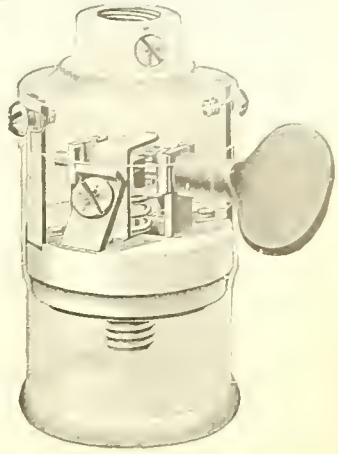

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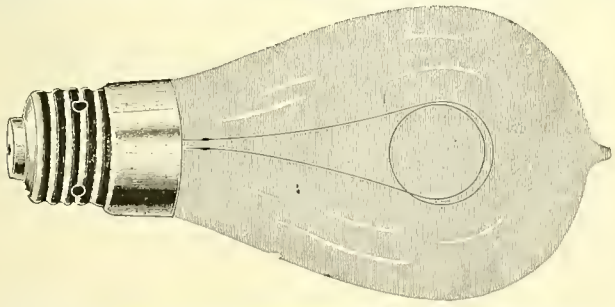

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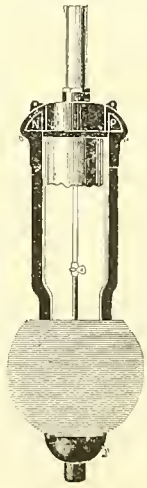

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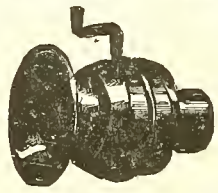

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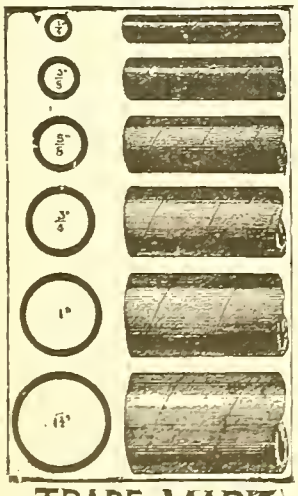

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The shipment of our new stopper lamps will begin early in January. In making this announcement, and in quoting prices, we take pleasure in giving particulars which will indicate some of the many advantages the users of our apparatus will enjoy.

First. The new lamps are made in separable parts so that the carbon burners may be replaced, and the glass parts used repeatedly, and their bases being moulded of uniform size to fit a specially designed socket, the lamps are neater in appearance than the all glass-globe form.

Second. The carbon burners will be preserved by an attenuated atmosphere of nitrogen, and their candle-power maintained more nearly constant than heretofore by means of a recent important discovery.

Third. Special sockets of neat design will be employed for these lamps, and special fittings will be supplied at five cents each, which will adapt any of the forms of sockets now in use to receive the new lamps, thereby bringing about exact uniformity in lamp bases.

Fourth. By reason of the manufacture of the lamps by special machinery and improved methods, by the use of nitrogen for preserving the carbons, and by means of pumping and charging apparatus recently perfected, **WE HAVE BEEN ABLE TO SO REDUCE THE COST OF MANUFACTURE AS TO FIX OUR PRICES FOR 8, 10 and 16 CANDLE POWER LAMPS AT 30 CENTS EACH, SUBJECT TO A DISCOUNT OF 10 PER CENT. TO OUR CENTRAL STATION CUSTOMERS,** and to others from 2½ per cent. upward, according to quantity, **WITH AN ALLOWANCE OF 10 CENTS FOR EVERY BURNED-OUT LAMP RETURNED UNBROKEN** to any one of our factories, making the net cost **OF RENEWALS FOR THE 8, 10 and 16 CANDLE POWER LAMPS 17 CENTS** to our central station customers. For 20 and 25 candle power lamps the prices will be 35 cents each, subject to the same discount and allowance for burned out lamps.

By long and careful tests, and by the use of a large number of these lamps in our works, we have demonstrated that the new lamp will have greater advantages for users than the Edison lamp or any of those heretofore upon the market.

The importance of the improvements in manufacture by which we have been enabled to offer these lamps at so low a price will be appreciated by all users who are aware of the constant deterioration in the carbon burners, and of the fact that the real commercial efficiency of a lamp is its average efficiency. With a constant amount of electric current the ordinary 16 candle power lamps rapidly fall below 10 candle power from deterioration of the carbon, when they must be renewed; and it results from this, that the users, with cheaper lamps will get from 15 to 20 per cent. more light from a given expenditure of electricity by a more frequent renewal of lamps than is now customary. Thus the low cost of the lamps may be made to add to the revenue of a lighting station in one of two ways, viz., either by giving a greater lighting capacity at the present cost of lamp renewals, or by actual saving in the cost of lamps with renewals made at the present period of renewal.

The problem of manufacturing a sufficient number of lamps to supply the entire demands expected from the users of electric light is a difficult one to meet quickly. We are preparing to turn out from 15,000 to 20,000 lamps daily, and in addition to this to renew the carbons in returned burned-out lamps to any extent that may be required. During the month of January we expect to be able to take care of all of our customers who must have the new lamps, and rapidly thereafter to fill all the orders with which we may be favored.

We are also contemplating the erection, as the business develops, of "renewal stations" in all large cities such as New York, Boston, Philadelphia, Chicago, Cincinnati and St. Louis, thereby reducing the cost of shipment and return of lamps for renewals, and still further reducing the net cost of the lamps to our customers.

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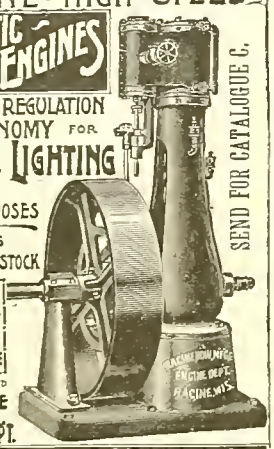

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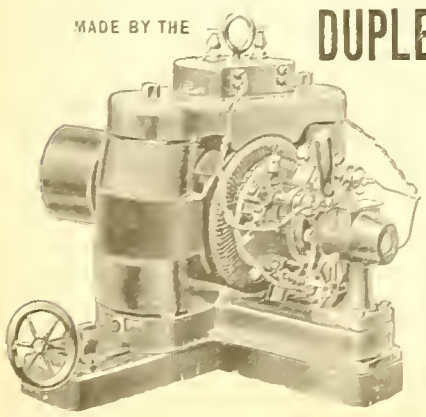

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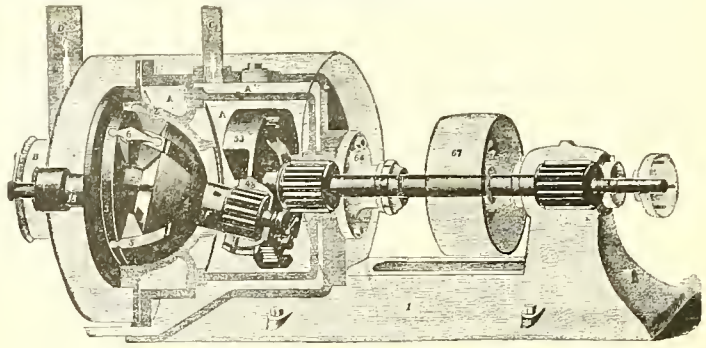

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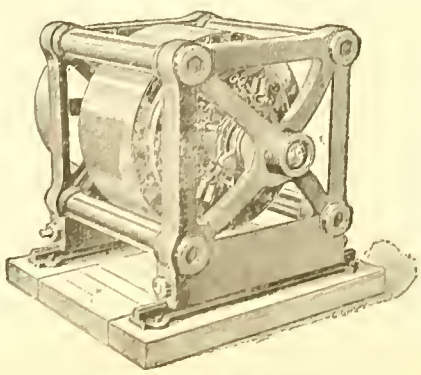

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Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, FEBRUARY 4, 1893. No. 5

Electricity at the World's Fair.

The Westinghouse plant at the World's Fair promises to be one of the most attractive features of the exposition, owing to the great size of the engines and dynamos and the thorough manner in which the work of installation is being done. The great 2,000 horse power Allis engine, with its fly-wheel 30 feet in diameter, from which will be driven two 10,000 light dynamos in tandem, will occupy a prominent position in machinery hall and is sure to be ever the cynosure of an admiring throng. The pulleys of the driven machines are immense affairs in themselves, as can be seen by a glance at Fig. 1. which is a reproduction of a photograph of two that are now in machinery hall. These pulleys are nine feet in diameter and over six feet face. Each has two sets of spokes, and weighs about ten tons. The castings are fine specimens of the founder's art and are a credit to the shops from which they were turned out. In Fig. 2 is shown a view of the Westinghouse section of the same building, with two engines already in position. These machines are of the type made by Westinghouse, Church, Kerr & Co. and are of 400 horse power each, designed to operate two 4,000 light alternators.

The work on the elevated electric railway is being steadily pushed, and there is no doubt that the line will be ready on time. Fig. 3 shows the process of laying the iron girders on the elevated structure, the view being taken at the southwestern corner of the transportation building.

Supply companies especially will be interested in the following circular letter to exhibitors sent out by Secretary Hornsby of the department of electricity:

In many cases those who have applied for space intend to exhibit the manufactures of others than themselves. Under the rules of the exposition this will not be possible, it being necessary that each manufacturer shall apply in his own behalf, or that some agent shall make individual application for him. If it is your intention to exhibit the manufactures of others than your own company, please notify me to that effect at once, and I will immediately see that you have blank applications for this purpose. These applications you will please fill out, one for each company or individual, and return them to me at once. You will please, also, on the application, give the numbers of groups and classes under which the exhibit of that special company will fall in the classification of this department, and I will have the name of that company, with the groups and classes, placed in the official catalogue for competition. The space which has been, or will be, assigned to you can also be given in the classification as the location of each of these companies. An immediate reply to this matter and its early attention will insure all of the companies which you represent proper representation in the official catalogue, which, under the rules, they will not otherwise get.

Although the elaborate lighting effects at the World's Fair have been frequently described in the WESTERN ELECTRICIAN and other technical papers, the writers for the daily press appear to be just waking up to the brilliancy that is in store. The following extracts are from an article in the *Chicago Journal:*

It will be at once seen that the great feature of the arc lighting of the fair will be the lights along the lake shore. To appreciate these properly one will have to journey out upon the lake or along the moving sidewalk to the end of the main pier. There can be no mistaking the prediction of the engineer in charge that the view of the lake side of the exposition after dusk will, from the standpoint of an electrician, be second to none in the world. There will be, first and foremost, that grand sweep of shore thrown into perfect contour by a single row of brilliant lamps, whose lights will be seen in duplicate in the waters below. Behind the first will be a second and higher row, and then a third, the lamps of which will hang in the loggias of the manufactures building. Flanking this bay of light will be, on the south, the great display on the main pier, where three iron pillars 120 feet high will stand, two surmounted by clustered lamps, and the third at the point of the pier by a search-light of hitherto unheard-of capacity, the rays from which will wing their way across the lake in undeviating lines to the Michigan shore. The initial candle power of this giant among search-lights will be 200,000, and its great lenses will multiply that power a thousand times.

The north pier will be another focus of light. The battleship Illinois will show a search-light from its fighting-top, and the government light-house will flash out its signals to belated lake mariners with a brilliancy equal almost to that of the great main pier light.

The eastern entrance to the manufactures building will be at night yet one more focal point in the lake-front display. Here, instead of clusters of three lights such as will be shown at other main entrances in the grounds, the clusters about the door will each include five 2,000 candle power lamps. One of the brightest spots during the day, where people will love to linger under the shadow of the building, watch the sails flit by and listen to dreamy waltzes from Hungarian bands or martial music from Dan Godfrey, it will not lose its reputation as a pleasant lounging spot by night.

Another favorite promenade, where bands will play and lights will shine, will be found on the terrace-walk south of the gallery of art. Here, too, the water will lend the artful aid of reflection to add new beauties to the opalescent glow. Upon this promenade arc lamps will be set of an ornate description, with handsome pedestals and incandescent pendants. These same lamps will figure largely in the decoration of the bridges, and the plans for them show great grace and stability.

Fifty-seventh street and that avenue of small palaces to the north which the states have taken for their own will be liberally supplied with the electric luminants, but for decorative effect will rely chiefly on the smaller lights upon roof-gardens and about the doors. One spot on Fifty-seventh street will be as light by night as by day. Between the annexes of the art palace a court of mosaic marble is to be laid by Italian workmen between the flower beds, and there the lamps will be but twenty feet apart.

The visitor entering the fair by the surface railroads will be greeted with a blaze of light from 100 pendant lamps outside the terminal. That will prepare him for the great scene in the grand basin, with its thousands of incandescent lamps, hundreds of arc lights, and, above all, the electric fountains. After that he will care to do nothing for a full half hour but watch the changing rainbow colors and the fantastic combinations of light, water and steam.

FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.

Dr. Cornelius Herz and the Legion of Honor.

A decree was officially published in Paris last week announcing the removal of the name of Dr. Cornelius Herz from the roll of the Legion of Honor. This fact is promulgated at the same time that the announcement is made of the seizure of papers in a Paris bank clearly demonstrating Herz's dishonesty. Herz's degradation is, of course, the consequence of the discovery of his participation in the Panama scandal. The official decree will doubtless meet the unqualified approval of *L'Industrie Electrique*, which, in an unsigned editorial in a recent issue, pays us respect to him in these terms:

"We attacked the personage sufficiently when he was all powerful to be permitted to say a word concerning him at this juncture, and to protest stoutly against the story that Cornelius Herz would have attained the highest rank in the order of the Legion of Honor because of his scientific work. When an author writes a good book the manager of the publishing house which brings it before the public is not ordinarily decorated. The electrical part that Cornelius Herz has played for a dozen years has been simply that of a broker in scientific-industrial matters. His collaborators have been:

"In the incandescent lamp, Werdermann, Napoli, and Reytier, all of whom are now dead.

"In telephony, Abdank-Abakanowicz, Paul Barbier, Kern, and Sieur.

"In the transmission and distribution of electrical energy, Cabanellas, Marcel Deprez, Frank-Geraldy, Sarcia, as well as a long list of engineers, forgotten to-day, connected with the Creil-Paris experiments.

"In *La Lumiere Electrique* M. le Comte. Th. du Moncel, Gustave Cabanellas, Frank-Geraldy, Hospitalier, Auguste Guerout, Marinovitch, Neylan, Palaz; to-day, Ledeboer and Hess (the last five foreigners). When we compared the rewards given to the collaborators with those obtained by the man of affairs who skilfully exploited their work, we reach the conclusion that in this century it is sometimes more honorary, if not more honorable, to sell science than to make it."

Important If True.

A short time ago some commotion was caused by the announcement that the idea of conveying current to motors on electric cars by means of an overhead trolley was originated and patented years ago by a man named Green, and that all later devices of this character were infringements. The patent was sold by Green to O. S. Kelley of Springfield, O., and it is now reported that Mr. Kelley has sold his rights to the General Electric company for a large sum. If this is true, the news will be of great importance to all other makers and users of overhead electric railway systems.

Chicago Electric Club.

At the meeting of the Chicago Electric club, on January 16th, at which papers on electric meters were read by Messrs. McFadden, Gilchrist and Wirt, there was an interesting discussion. The papers were published in the WESTERN ELECTRICIAN last week. F. B. Badt presided at the meeting. Following is a stenographic report of the discussion:

LOUIS A. FERGUSON: I would like to know if the Aron meter is designed to be used in connection with the alternating current.

THE CHAIRMAN: Some Aron meters have been used on alternating systems satisfactorily.

P. J. MCFADDEN: In answer to Mr. Ferguson's question, I will say I am quite sure that it is used on the alternating current systems, because the conditions mentioned by the French engineers in the competition for the prize provided that the meter should be a watt meter to run equally well for alternating and direct currents, and the prize was divided between Prof. Aron and Prof. Thomson.

THE CHAIRMAN: I would like to have Mr. Wirt explain the constant of the Aron meter in relation to the value of gravity at different places. The pendulum of the clock runs faster or slower in accordance with the distance from the center of the earth, due to what we usually call gravitation. Now, supposing the meter to be calibrated in Chicago and taken to Helena, Mont., what would be the result?

CHAS. A. WIRT: Gravity would affect the two pendulums alike, and they would both increase at the same rate, and the increment due to magnetic force would be practically in the same ratio as before. But that brings up a point I meant to have spoken of, namely, the extremely small margin the Aron meter works on. These pendulums run at the same rate when any current is passing through the coils. I have heard of a device for making the pendulums synchronous when the variation is small. The total increase in rate of the magnetic pendulum with the full load on the meter is only one part in a thousand. To get the reading of the meter you have got to differentiate the one-thousandth part. It is apparent that a very slight change in the rate of either pendulum will give you a somewhat serious error. Whether that becomes serious in actual practice I can not say.

THOS. G. GRIER: The two pendulums are of different shapes and different material. Will their rate remain the same relatively in different temperatures?

MR. WIRT: The fact that they run at the same rate indicates that their centers of gravity are at the same point, and the rods being of the same material they ought to operate at the same rate.

MR. MCFADDEN: I would like to know if the clockwork is the same for all sizes, except the coils and pendulums?

MR. WIRT: I have not seen very many of these meters, but see no reason why a change in dials and pendulums should not be all that would be required.

MR. MCFADDEN: I noticed that instead of a permanent magnet there was a single pendulum in some of these meters.

MR. WIRT: I remember when the Aron meter first came out the description answered to the style you speak of; in that case the meter had hands, and the reading was gotten by the difference between the time of the meter and the true time. I think that the fact of the variation being so small is sufficient to account for that form being dropped, because if you had to take the difference between your meter and the true time at the place where you happened to be the little variations that would take place in your clock-work would wipe out the possibility of reading the meter correctly. It would evidently be of great advantage to have two sets of clock-work in the same case, made in the same way, which would be utilized together and would be liable to vary at the same rate, in order to avoid that difficulty.

C. G. ARMSTRONG: I have had experience with several kinds of meters. I had some experience with the Thomson watt-meter in testing an electric elevator. I wanted to take current readings on an electric elevator, and as you probably all know the readings have to be taken very hurriedly; sometimes inside of 15 or 20 seconds. I got a Thomson watt-meter and I found that notwithstanding the fact that the load was thrown on very suddenly and thrown off again, and then on and off, the meter read fairly accurately. I found that the point which Mr. McFadden mentioned about the disk taking about so long to stop seems to be true; that what it loses perhaps in starting it gains in stopping; so that it seems to about balance, and, as near as I could tell by comparing it with readings with the watch and with the ampere-meter and volt-meter, they were quite near together. I believe that the watt-meter was more nearly correct than anything else, and I am using it for both direct and alternating currents. I like the meter from the commercial view, because the customer can see what he is getting. There is something about the mystery of a bottle and the great certainty of the bill when it comes in which is appalling to the customer. With the Thomson watt-meter, or with any watt-meter, where the indication is read from a dial, the consumer can from time to time see how his bill is climbing up, and he is not quite so much astonished at the end of the month. While I have had no practical experience with the Aron meter, I may say that I think it is too delicate for commercial work. It may be a very good toy for laboratory use, but it would not be of any value whatever in the market as a meter. The intensely practical American people want something that is simple, that is not liable to get out of order, and something that can be understood by ordinary people, who, after all, make up the majority of those who are handling the practical apparatus. It is all right to place refinements in a station where they are to be handled by men of experience, but even here I find in a great many cases that we make grave errors in putting too fine apparatus into the hands of an ordinary dynamo tender. He does not appreciate it, and he uses it with less skill than he would if he had something much more ordinary. We would get far better results with cheaper and plainer apparatus.

MR. FERGUSON: Customers can see what the meter is registering, but they do not know whether the meter is right unless they know how to test it. All Thomson watt-meters are made on the principle that one revolution of the disk corresponds to a watt hour. In other words, one watt takes one hour for one revolution, and any larger number of watts, 540 say, would take 1-540 of an hour, or of 3,600 seconds, to make a revolution. The customer can time his disk and see how many seconds it takes to make a revolution. Or to do the same thing, use this formula:

$$W = \frac{r \times k \times 3{,}600}{s},$$

in which W is watts, r is revolutions, k is constant, 3,600 is time, and s the number of seconds observed.

MR. WIRT: I think the importance of the customer knowing the state of his readings exists principally in a sentimental sense. It may be a satisfaction to know that he can read his meter, but I don't believe that he will do it. The objection is always made against the Edison meter that it is blind, that the customer cannot read it and will not have faith in it. Well, in reply to this it may be said that it takes very little time for them to acquire faith in it. They soon learn that their bills bear a proportion to the amount of service rendered. There are one or two things against the electrolytic meter, and while I have somewhat of a sentimental feeling in favor of it I expect to see it go out of commercial use in the course of a few years. The worst thing about it is that if it does not go perfectly straight—and nothing ever does go perfectly straight—the electrolytic meter is going to work against the company. It is the total depravity of inanimate things that makes it come out so. And that is not all; it has a tendency to read slow, and reads slowest when the load is lightest. Consequently, in the summer, when the company needs every cent it can get, when the customers are not using much current, the company is receiving 10 to 20 per cent. less than it ought to receive. The metal chosen for the electrolytic style has the least variation of counter-electromotive force with the variation in the current of any commercial metal that it is possible to use. But steel varies with temperature, and we have been told how it is compensated for by a spool. That is easily accomplished, as the variation in the resistance liquid can be ascertained, but the contact resistance of the plate is somewhat variable, and it varies on the wrong side. In other words, the resistance of the steel in figuring the constant of the meter is taken at its normal value when the steel is fresh and the surface clean; when oxydized the resistance of the oxide cannot be allowed for. The oxide always increases the resistance, so that it reads slower and slower toward the end of the month. I do not want to be understood as saying that this is a frightfully serious matter, or we would not see the meter used; but, as a matter of fact, it does read slower at the end of the month, and the resistance is affected by the amount of current passing. A large current passing through the bottle tends to remove some of the oxide, so that the meter reads a little faster on full load than it does on light load; consequently with the light load the reading is not what it should be. I have another objection against the watt-meter. It is not a real objection, but a comparative objection. We hear a great deal said about the beauty of being able to read your current in watt-hours. The fact is that current is distributed in these days, almost without exception, at constant pressure. Constant pressure theoretically amounts to constant pressure actually, but, as we have seen here to-night, the pressure will vary occasionally, but the watt-meter does not average it properly. We are not buying watts on an incandescent circuit, but light. Nobody has pretended to give us a meter that will read in candle hours, but one that will read in watt hours. The result is that as the pressure drops 5 per cent. the meter takes care of that; it measures the watts accurately, and we get that 5 per cent. taken off from our meter readings. But when our light has gone down 50 per cent. we are paying 45 per cent. more than we ought to. It is not very much comfort to us, if our light goes down 50 per cent., that we get 5 per cent. rebate on the bill. I can see in the case of electric railway service where the pressure is extremely unsteady, that the watt-meter may be desirable and practical. In the case of electric light service I hardly think it is, and it is an injustice to the buyer.

THE CHAIRMAN: Take one of the meters that simply measures currents, wouldn't the same objection hold good there? If you simply measure a current, and if the voltage that goes down the current decreases very little and the voltage comparatively little at the same time, and has the same effect on the light, while you pay for virtually say five per cent. less current you pay for 50 per cent. less light.

MR. WIRT: Of course I do not claim that the Cooley meter really does measure light. It does not pretend to; but by implication, at least, it is held forth that the watt-meter does give the customer a square deal, whereas it is more or less a pretense if the customer is buying light and paying for watts.

MR. MCFADDEN: I think the matter of paying for lights is a matter between the consumer and the station man who bases his charges on the lamp hour or candle power hour. We furnish a meter that will measure it accurately in watts and give that to the station superintendent as such. He can sell current to the customer as watt hours or lamp hours, just as he chooses. It is a matter of detail with him. I have run a hundred volts on two wire 110 volt meters—I have run them at 92; I don't know how much lower they would go; and as high as 125, and it was still accurate. I have done it in the shops but never in practice.

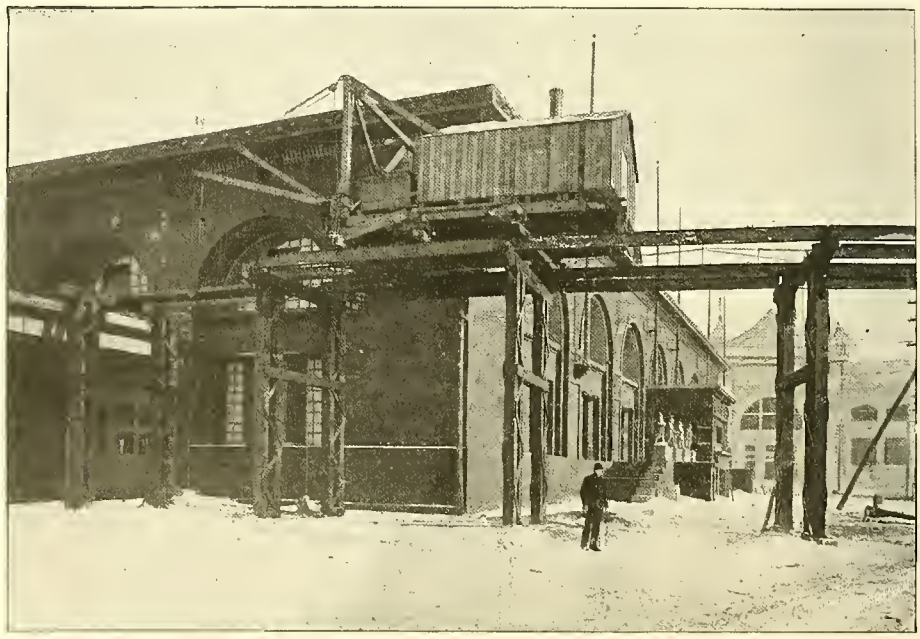


FIG. 3. ELECTRICITY AT THE WORLD'S FAIR.

MR. GRIER: That question came up not long ago where one of the Thomson watt meters was used. The voltage varied from 100 to 117, according to the load, at different portions of the building in which the station was located, and the meter read apparently according to the measurements taken with a Mason lamp meter and a Mason volt-meter in circuit, and it apparently measured accurately anywhere from 100 volts to 117. One peculiar thing was that while the customer was kicking very hard about his bill it was found that the meter read 5 per cent. too slow.

MR. GILCHRIST: I would like to say in answer to Mr. Wirt's remark in regard to the electrolytic meter running slow on a light load, that the idea of the Chicago Edison company is to have a meter constructed in such a way that, where a very large meter is used that is liable at times to run with light load, it will register on two small bottles, and then when a heavier load is thrown on it is shunted onto two heavier bottles. In that way we expect to get rid of the loss occasioned by the meter running slow on a very light load. We find that necessary in our South Side residence station. We have a great many residences there which are wired for a large number of lights, from 500 to 1,000, and where at all times in the year, especially in the summer months, the average load is very small indeed, as low as 10 to 25 or 50 lamps.

MR. WIRT: What is the gain with the light load from the change of bottles?

MR. GILCHRIST: We get rid of any inaccuracy which may occur in running a very light load on a very large meter.

MR. WIRT: You have the same difference of potential, then.

MR. GILCHRIST: We use different bottle shunts. It is to be applied especially in these new meters. We have

not used them yet, but there is one being made up for us now. But ordinarily the ratio of the large circuit to the shunt circuit will be as much as exists in the No. 1 meter; that is the smallest meter, which will read down to 1 milligramme in the bottle. In the cases of very heavy loads it will be thrown on the highest resistance shunt, so that 8 amperes on the main circuit will only read 1 milligramme in the bottle. We also get rid of any difficulty with oxide.

MR. MCFADDEN: I do not remember whether in reading his paper Mr. Gilchrist spoke about the thermostat. If the lamp was burning all the time would, the current go through the bottles?

MR. GILCHRIST: No, I did not mention the thermostat at all. We have 3,000 meters out, and the first year we started we sent on an advance order for a dozen thermostats. I think we have four of them out, and the other eight are still at the station. But the current of the lamp does not register on the meter. That is the producer's loss. But it is set in such a way that the lamp only burns over a small portion of the time. Of course if it was in a very cold place, or if the weather was always as cold as at present, the probabilities are that the lamp would burn about half the time.

MR. ABBOTT: What results have been obtained in putting the watt-meter on the primary of the alternating circuit?

MR. MCFADDEN: There are not very many of them. In every case they register as accurately as on the secondary. Take a meter wound for fifty volts. The current on the secondary is at fifty volts; the armature circuit of that is cut down by the resistance in the back, the main circuit going through the meter as before, the same as the case of an ordinary meter in a building. The secondary meter requires a special transformer.

MR. ABBOTT: That would be all right where there is a load. Suppose you have transformers in the circuit with the secondary open; then there is a current passing back and forth all the time.

MR. MCFADDEN: It will measure the current of the primaries.

MR. ABBOTT: It will give a reading, will it not?

MR. MCFADDEN: Certainly.

MR. ABBOTT: The secondary beyond the transformer being open?

MR. MCFADDEN: Yes, if there is no load being taken off the secondaries by the customer in the aggregate that will amount to something of a load for the station meter, and it will register.

MR. ABBOTT: And therefore it will not be a true indication of what the customer has used?

MR. MCFADDEN: Not entirely.

MR. ABBOTT: Do you find any inaccuracy arising from a loss of magnetism?

MR. MCFADDEN: No. This meter has been made, I think, less than two years. This summer I was at the works, and I saw some magnets which had been in use from the time they were started and they hadn't lost anything which could be measured. Even since that they have improved by aging them. The magnets are made in the first place steel which of it is found by experiments will retain the magnetism the best of anything. We use Tungsten's steel. They are made into magnets and put through the aging process. I do not recall exactly what it is, but the chief part of it is boiling for a number of hours. After it is once aged the strength is measured on a beam with a slide passing through, so as to have the beam in equilibrium. Then the magnets are sent back and aged again, and that process is repeated until the results are satisfactory. Where the meter will run fast, which is very rarely, it may be laid to the fact that the magnet is cracked, and therefore the magnetic circuit being poorer the magnet is weaker. That very rarely occurs, and it is entirely a mechanical accident.

MR. ABBOTT: Do the customers ever place a big horseshoe magnet under the meter?

MR. MCFADDEN: I have never heard of their doing so, but of course they might do it. But the current would cost them something. Occasionally companies find that the meters have been tampered with. Just in the same way we have found that customers we have been charging on the basis of 16 candle power lamps have bought and put in 32 candle power lamps, and in that way almost doubled their illumination.

MR. GRIER: What is the effect of placing a piece of iron near the watt meter?

MR. MCFADDEN: Unless it is a large piece it would not make any difference, but if it were a large piece it would make it go slower if it were near the disk.

MR. GRIER: What would be the effect of laying a heavy piece of iron near the Shallenberg meter?

MR. MCFADDEN: I don't think it would make any difference; the Shallenberg has a revolving fan.

MR. FERGUSON: What percentage of the average load of the station is consumed in the watt-meters?

MR. MCFADDEN: There is a current going through the armature all the time at only 1-10 of an ampere; the station is paying for it, but it is not being registered. If the lamp is off, and you have the armature current going all the time, and you turn the switch you will see that the thing will give a little twitch, but not enough to make it go; but the moment you turn one lamp on it goes at once. That is not essential to the meter, except to make it sensitive to light loads, and it can be avoided by an automatic switch.

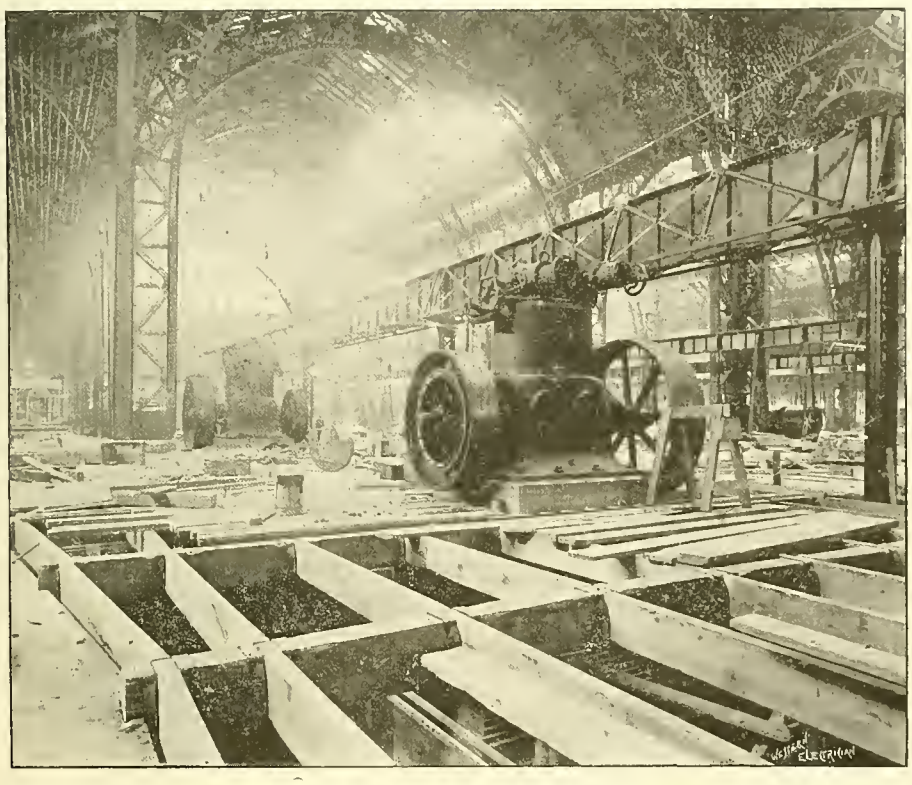


FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.

MR. FERGUSON: That construction of meter is such that the same current passes through the armature from all sides?

MR. MCFADDEN: Yes.

MR. WIRT: I estimate that the amount of current required for the meter would cost about $8 a year at the regular price.

MR. MCFADDEN: If you are charging that to expense, you should charge the actual cost.

MR. FERGUSON: We have three hundred meters and it takes three hundred amperes for 24 hours, 365 days in the year. That is a good deal of money. We charge a dollar a month down town, even though the bill should be less than that for the current consumed; we never make a charge of less than a dollar.

MR. ARMSTRONG: The Shallenberg meter has been rather neglected to-night, but I suppose you are familiar with it. The main difference between that and the Thomson meter is that they have a fan for a retarder in place of magnets, and the disk is of copper. They claim that that is better than the Thomson, because they use no current when it is not in use. They have never yet attempted to use it on a direct current; it is a fairly good meter. It is strictly an ampere hour meter. It uses no current when not in use, because it is only out one side of the circuit. They use this meter also for primary current. They will take the ordinary 20 ampere meter and put it in the primary, and multiply the result by whatever transformation you are using. I heard of one peculiar incident in connection with the Shallenberg meter where it was found that the customer was not paying anything for his current, and upon investigation it was found that a spider had got inside and made its web around the fan and it was tied up so that the meter could not run.

Invention of the Incandescent Lamp.

BY FORBES BAIN.

Apropos to the recent excitement and discussion in reference to the incandescent lamp, it may be interesting to take a retrospective glance at the state of the art at the time the now "much litigated" lamp was offered for patent protection. When Columbus answered the interrogation put to him by some of his less fortunate and less ambitious countrymen who questioned the need of ability to discover a new world, as any man, they said, could do that by simply sailing west, he asked if they or any of them could stand an egg on its end. He showed them how easy it was to accomplish this by simply crushing one end of the egg, when it would stand erect on the crushed end. It would not require ability to stand an egg on its end in this manner after having seen Columbus perform the act, or to have read of the manner in which he did it; neither would it indicate an amazingly bright intellect to stand a goose egg on its end in this manner, after Columbus' method of making a hen's egg maintain an upright position was well known.

Without making an extensive research, it may be said that as far back as 1799 a work on "Electricity" was published in which (Chapter XIII.) "The Electric Light in Vacuo" is considered. Under the heading "Experiments on Electric Light by Mr. William Morgan," is the following:

"Proposition 1. There is no fluid or solid body in its passage through which the electric fluid may not be made luminous. * * *

"Proposition 2. The difficulty of making any quantity of the electric fluid luminous in any body increases as the conducting power of the body increases."

At the time this was written, chemical, or dynamic, electricity as it is called, was not known, but the foregoing propositions offered very apt suggestions to the experimenter to be verified with the galvanic cell, which, of course, was done.

This would naturally lead us to the conclusion that the conductor in an incandescent lamp should be of a nature that its conducting power would not be great, or its resistance high; therefore if we should select carbon for our filament, we have the knowledge that it must be slight and of great resistance. Mr. Morgan discovered this peculiar condition, which he laid down as a demonstrated fact. We could not claim the use of carbon an invention at the time of Edison's experiments for it was used by Starr in 1845. His lamp consisted of a carbon conductor sealed in an exhausted glass globe. His carbon rod or stick was thick, but Morgan has told us that it should be of high resistance to get the best results. The well known Geisler tube, invented by the man whose name it bears, about the year 1840, is a vacuum tube of one piece of glass, provided with platinum wires which are passed through and fused into the glass.

If we take Geisler's tube or globe, which is made of one piece of glass, having platinum wires sealed into the glass, the tube having the air exhausted, and in this place Starr's carbon conductor, fashioned after the suggestion of Morgan, we will have a modern electric lamp and this without any invention on our part. Now if we want our carbon conductor to have the horse shoe or loop shape, we have a suggestion from the English patent of S. W. Konn, January 8, 1872. "This invention relates to the production of heat" and presumably light, "by electricity, by the employment of solid stems of carbon within hermetically closed vessels, charged with azotic or other gases which do not support combustion." * * "The illustration represents one form of this apparatus a being a V-shaped carbon bridge." Now if we found it necessary to enlarge our carbon loop or filament at its terminals we have this suggestion in the English patent of Kosloff of St. Petersburg, Russia, February 5, 1875: "The electric light is produced by means of the electric current heating to a white heat sticks of carbon placed in circuit and being enclosed hermetically in a globe filled with nitrogen gas; a carbon rod has its ends inserted in blocks of carbon which are supported between two insulated arms."

It seems plain that a very efficient and practical incandescent lamp can be made from the suggestions contained in the references cited, which antedate the application for a patent of the Edison lamp from 5 to 80 years.

The town of Florence, Colo., wants an electric light and power plant, and a franchise could be obtained for it and the neighboring towns of Coal Creek, Rockvale and Williamsburg, and the mines adjacent.

Non-synchronous Motor for Ordinary Alternate Currents.

By C. E. L. Brown.

After numerous experiments with multiphase motors, I had become convinced, about a year and a half ago, of the possibility of constructing motors for ordinary alternate currents possessing all the characteristics which, till now, have been attainable only by the use of multiphase currents. Among these characteristics of multiphase motors I would specially call attention to the following:

First and most important, absence of collectors and brushes, and consequent simplification of design and reduction in the amount of attendance necessary; secondly, the possibility of starting the motor against a load, and thirdly, non-synchronous running, with the advantages connected therewith.

The absence of collectors has, in very many cases, caused the multiphase motor to be considered preferable to the direct current motor, so that, without exaggeration, we may say that the alternate current—though not, it is true, in its simplest form—is considerably in advance of the direct current as a means of driving motors. When we also consider the ease with which the alternate current may be transformed, we can understand how in all the newer power distribution schemes the alternate current of two or more phases has been employed. A disadvantage is nevertheless soon apparent, to which too little attention was at first given, viz., the complication of the mains, arising from the fact that more than two wires are necessary. This disadvantage is chiefly apparent in cases of combined distribution of light and power, and creates a demand for a motor for ordinary alternate currents of equal simplicity with the multiphase motors and possessing their various advantages.

Attempts have not been wanting to produce such motors. This is best seen by the large number of patent specifications filed, in hope of attaining this end. I do not here propose to consider in detail these attempts, merely remarking that they have been all more or less unsatisfactory, none of them having, to my knowledge, been adopted in practice. The reason of these unfavorable results seems to be the same as that which, until recently, prevented the construction of practical multiphase motors. I refer, primarily, to the want of attention to the magnetic resistance of the air-gap. Owing to the abnormal magnetizing current required, the windings, even while the motor was running light, became so warm that continuous running was out of the question. The efficiency was also, consequently, very low. I have, as is well known, by placing the wires in holes through the iron (both of the fixed and rotating parts), entirely overcome this difficulty, and thus produced the first really practical multiphase motor. Another defect was in the form of the magnetic circuit, with prominent poles, which produced injurious reactions in the induced part, rendering the starting of the motor very difficult.

I would also call attention to another point, which is specially noteworthy in American practice, viz., the high frequencies commonly employed. This causes difficulties from the great counter electromotive force of self-induction, as well as from the inconveniently great number of poles required on small motors, in order to avoid excessively high speeds. There are several other reasons why these earlier experimenters have failed, but I have, I believe, already enumerated the most important.

After these preliminary remarks I will now proceed to describe my new motor, first noting the remarkable phenomena upon which the principle of it is based. I have observed that a conductor placed in an alternating field, Fig. 1, if set rotating with a certain velocity, will itself run up to practically synchronous speed, and then has the tendency to keep to this speed against a load. Currents are induced in the conductor by the alternating field. So long, however, as it is at rest, these currents are neutral with regard to the inducing field. As soon as the conductor is set in motion this condition ceases, and a turning movement is produced, which increases as the speed rises, till synchronism is nearly attained. The following points should here be noted: With a conductor in the form of a solid disk, for example, the speed will drop more or less below synchronism, according to the load. With a deeply serrated conductor, on the other hand, or one consisting of but few members, the tendency is to preserve almost exactly synchronous rotation, and if the speed once falls much below this the torque is considerably reduced.

It must also be noted that the direction of rotation is quite indeterminate. The conductor tends always to attain synchronous rotation in the direction in which it was first set in motion. The arrangement shown in the diagram, Fig. 1, is, of course, not suitable for practical motors. In designing a motor based on these facts, the following points must be kept in view. The alternating field must be as strong as possible and all magnetic resistances (as well in the inducing as in the induced parts) must be reduced to a mimimum. Injurious eddy currents in both iron and copper must also be avoided as much as possible. These various requirements can be satisfied in the following manner: The inducing winding (i. e., that in connection with the mains) as well as the induced (receiving its current by induction from the former) are provided with iron cores consisting preferably of iron disks insulated from one another.

In order to reduce the magnetic resistance, the windings are embedded in iron either in holes of suitable shape, Fig. 2, or between teeth, Fig. 3, which may be advantageously closed by a winding of iron wire, Fig. 4. The teeth may also, as in Fig. 5, be widened, so as to nearly close the opening. Either inducing or induced parts may, of course, be provided with either of these arrangements.

The inducing winding may be, of course, of any of the usual forms, with a suitable number of poles, the sections being connected in series, parallel, or in a combination of both. The induced, which is usually also the rotating part, since sliding contacts are thereby avoided, carries a short-circuited winding preferably insulated from the core, in order to avoid eddy currents. This short-circuiting may be carried out in several ways. All the ends at each side may be connected together by means of two copper rings, or the conductors may be connected in certain groups, which are separately short-circuited. Or, again, wires similarly situated with regard to the external field may be separately short-circuited with one another. Another method is to wind the induced part as ring, drum, etc., with a short-circuiting connection. For regulating the speed a resistance choking coil or capacity may be inserted in the short circuit.

Figs. 6 and 7 show the most important points about a motor designed on these principles. The inductor *J* is shown fixed and consists of a cylindrical core of laminated iron. The disks of which it is built up are perforated near their inner edges and carry the winding *W*, here shown as a ring. It could, of course, equally well be wound as a drum. The winding is not shown extending over the whole ring, but there is nothing to prevent it being so arranged. The connections are such that the poles are produced at *PP*. The rotating part consists principally of a laminated iron cylinder carrying insulated copper wires *S* in holes close to its circumference. These wires are soldered at each end to stout copper rings *K*. A somewhat different arrangement is shown in Figs. 8 and 9. This has the property, described at first, of almost synchronous running.

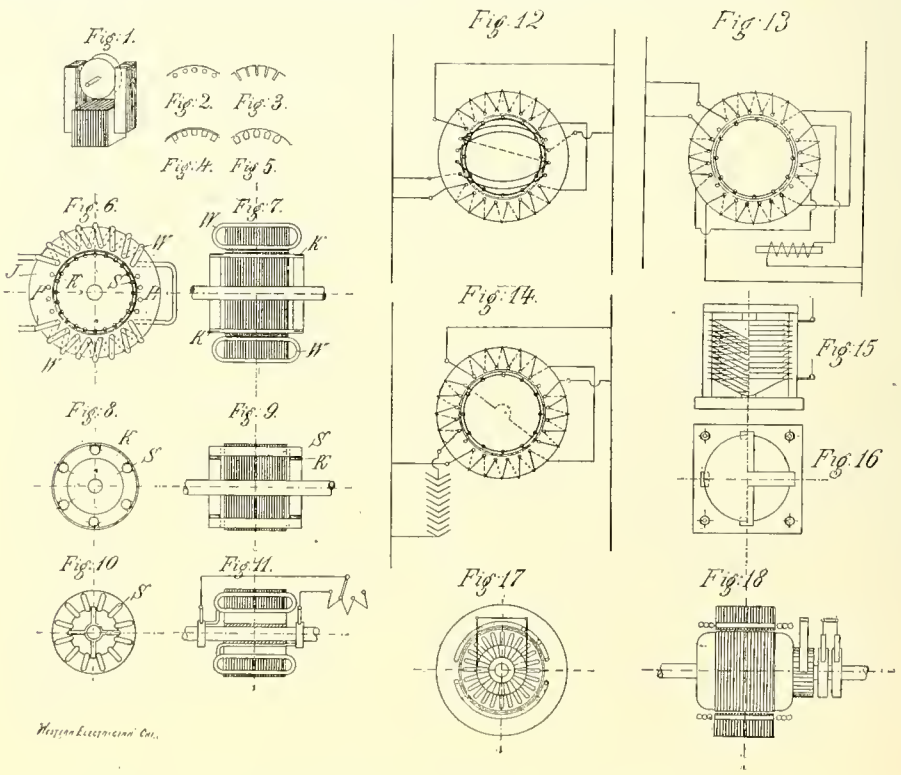
Here again copper conductors *S* are bedded in a laminated iron core and soldered on both sides to stout copper rings *K*, the only difference being that the number of conductors is here very small.

Figs. 10 and 11 show another type of rotating induced part, provided with a ring winding *S*. Two opposite points are here connected to sliding contact rings, so that a resistance for regulating the speed may be readily inserted.

A motor constructed according to these principles and suitably proportioned has a remarkably high weight efficiency. I have designed a non-synchronous motor, for example, weighing only 150 kilogrammes, which at about 2,000 revolutions could be loaded to 6 horse power without excessive heating. Its efficiency is very good, and the apparent watts are but very slightly more than the true watts. The outside dimensions of the motor without pulley are: Length (along shaft), 340 millimeters; greatest height, 350 millimeters; greatest breadth, 340 millimeters. These figures suffice, I think, to show that the output of this form of motor is scarcely behind that of the one for direct or multiphase currents.

I may here briefly touch upon an important point, viz., the predetermination of the so-called "idle" or magnetizing current, as it is, of course, necessary in designing a motor to be able to calculate this current. Experiments with a large number of motors of various outputs show that this may be done with efficient accuracy for practical purposes, the observed currents differing in most cases by only a very small percentage from their calculated values. The same principles apply here as in the designing of ordinary dynamo machines.

As regards induction in their coil, current density in the copper, etc., similar rules apply as for ordinary dynamo design.



FIGS. 1 TO 18. NON-SYNCHRONOUS MOTOR FOR ORDINARY ALTERNATE CURRENTS.

As it would have occupied too much space to go at length into all the questions involved in the calculations for these motors, I have merely sketched out the broad principles upon which they rest, wishing especially to point out that the calculations for such motors are similar to those which have long been in use for direct current machinery. I may add that what I have said applies equally to multiphase motors, and in fact it should be clearly understood that with both broad types of motors the same principles apply throughout.

A motor designed in accordance with the principles already described has similar properties to a multiphase motor, i. e., has no collector, runs non-synchronously and, as far as efficiency and output are concerned, is also very similar. In one respect only does it differ considerably from a multiphase motor, viz.: It will not start itself, and some method must therefore be found of neutralizing this disadvantage. There are several ways of doing this, a few of which I will describe.

The motor may, for example, be provided with a second winding, wound in the spaces of the first, and which, being only a short time in action, may be of relatively small section. By giving this winding a different self-induction to the first and connecting the two in parallel the resulting phase-difference produces a rotarting field starting the motor and bringing it up toward synchronous running. This second winding can now be cut out and the motor

will continue to run as a single phase motor as described. The difference of phase in this second winding can be attained in several ways. One method is to wind one section as drum and the other as a ring, as in Fig. 12, as it is well known that the latter has considerably greater self-induction than the former.

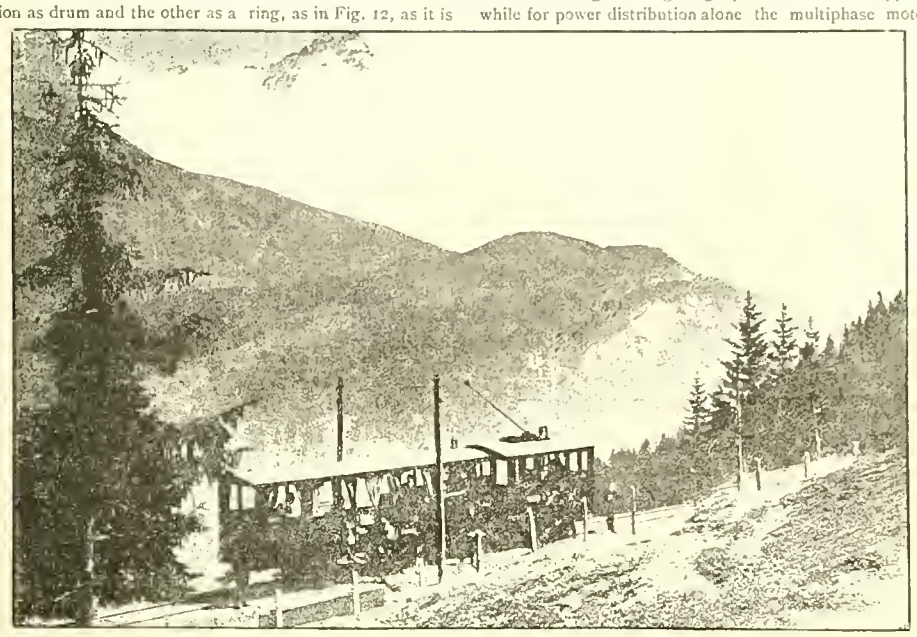


FIG. 2. ELECTRIC RAILWAYS IN SWITZERLAND.

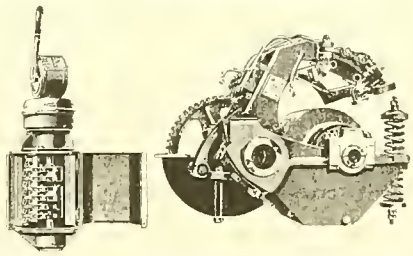
We may further attain the same end by connecting a self-induction, Fig. 13, or capacity, Fig. 14, or a resistance in series with one section. This method may of course be used in conjunction with the already described mixed winding. In order to obtain conveniently the necessary capacity, we may use a series of elements which Messrs. Stanley and Kelly have also lately employed in their experiments with alternate current motors. A very convenient form of water capacity consists of a large number of iron disks dished out to a conical form, piled together with insulating distance pieces to allow room for the liquid, Figs. 15 and 16. A solution of soda in water may be employed for filling. As a further method of obtaining the necessary difference of phase, suitably proportioned transformers may also be employed.

By means of this difference of phase, in a suitably proportioned motor a very considerable starting torque may be obtained. Thus I have suceeded in getting with one 1½ horse power motor, a torque corresponding to a load of 3 at full speed.

Another method of starting single phase motors consists in providing the induced, usually the rotating part, with a winding connected with a collector, Figs. 17 and 18. By means of suitable brushes we may either supply this winding with current from outside or the brushes may simply be short-circuited. As soon as the latter are in their proper position with regard to the external field a powerful torque is produced and the motor starts. As soon as a sufficient speed is attained the collector may be short-circuited by means of brushes pressing on contact rings connected with opposite points of the winding, or the winding may be short-circuited by means of a conducting ring brought into contact with the collector. The motor then works in the manner described. In this case the inducting part is wound in the simple normal manner, i. e. it requires no second winding for the purpose of obtaining a difference of phase. On the other hand the induced part has, instead of its simple short-circuited winding, a drum or ring winding, or it may be wound like the armatures of the Thomson-Houston or the Brush arc light machines.

Having now described a few methods by means of which the motors may be started, I must not omit to say that these non-synchronous motors for ordinary alternate currents may be built of any size, from quite small types to machines of 100 horse power and more. I believe that I shall not go too far when I say that in the simple motors described we have a means of securing the speedy and certain extension of the use of ordinary alternate currents. These motors will be especially employed where light and power together must be supplied in the simplest manner possible.

Regarding the amount of attendance necessary and safety in running, these motors are considerably in advance of those for direct currents and as far as commercial efficiency for the same size, output and speed are equally good. I am of the opinion that this new type of motor will displace multiphase motors in all those cases where, in addition to general lighting, power must be supplied, while for power distribution alone the multiphase motors will still find a use. In light and power distribution systems having the so-called two phase current an advantageous combination of the two types of motor may be made. Thus small motors may be connected simply to one phase like the lamps, while larger motors may be connected to both phases.



FIGS. 3 AND 4. ELECTRIC RAILWAYS IN SWITZERLAND.

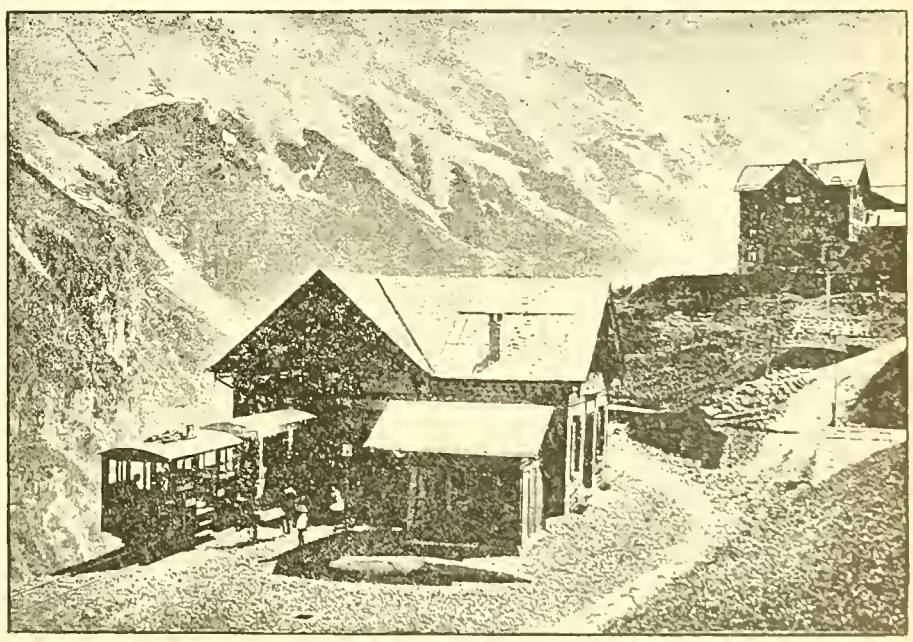


FIG. 1. ELECTRIC RAILWAYS IN SWITZERLAND.

Electric Railways in Switzerland.

The idea of constructing railways in Switzerland appears to shock the æsthetic feelings of an English contemporary, and it utters this mild protest: "It would seem that the Swiss are bent upon spoiling their country as much as possible. Whenever they find an inaccessible precipice they run a railway up it. They are proposing a railway up the Jungfrau itself. The Philistinism of the A[illegible] was shocked at the bad engineering of the to[illegible] and who sent in an estimate for making it vert[illegible] before that of the Swiss railway projector. T[illegible] ways are generally worked by steam. There [illegible] justification for the objection that 'the smoke a[illegible] noise of the engines are out of place," and no one w[illegible] fault with the conclusion that "if mountain railways m[illegible] be used they should by all means be worked electrical[illegible] and thus avoid both smoke and noise." Moreover, [illegible] journal in question points out, electricity is also much cheaper, as there is always water power available, and this is a point that will appeal to the constructors much more forcibly than any other.

The cause of this protest was the construction of an electric railway above Lauterbrunnen, Switzerland, 5,000 feet above the sea level, and commanding an excellent view of the Jungfrau chain. Views of the road and the power plant are presented in Figs. 1 and 2. American practice is closely followed in the construction of this road. The generators employed are multipolar machines with drum armatures, the conductors being connected across, so that two brushes can be used. The lower part of the field magnet is cast on the bed-plate, and the bearings are mounted on round-footed pedestals which fit upon surfaces bored at the same time as the field magnets. The motor delivers 17 horse power to the axle at a speed of 425 revolutions per minute. It can, of course, give a much greater output and a large starting torque. It is shown in Fig. 4. The field is made up of two steel castings—lightness and compactness being of paramount importance in this case. A single reduction gear working upon a 4 inch axle is employed. The field magnet coils are made of strong insulating material compressed in special molds. The armature is wound with embedded wires. Notches are employed with openings sufficiently large to admit the wire without threading, several wires being arranged in each notch. Fixed carbon brushes are also used. As these brushes do not need to be put forward, a very small air space can be employed; hence the possibility of exceedingly small field coils.

The axle wheel is of steel, with a phosphor-bronze pinion having a new shape of teeth, which are said to work noiselessly and without any "play" whatever. The motor is mounted on a truck with 30 inch wheels, and its lowest point is 3¼ inches above the level of the top of the rails. The length is also small, so that a pair of motors can be easily mounted on a bogie with a 5 foot wheel base.

Fig. 3 shows the controlling gear. It has a double motion, and controls the car both as to speed and direction of motion. It is specially designed to deal with a 600 volt circuit through an inductive system without troublesome sparking. This form of regulator is employed both for tramways and electric railways. The cuts are reproduced from London *Industries*.

At the annual city meeting of Rockville, Conn., it was voted to indefinitely postpone action on the proposal to appropriate $25,000 for the purchase and installation of an electric lighting plant.

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CAREFUL and discriminating readers of electrical journals cannot have failed to notice the tendency on the part of some of our contemporaries to impose upon their readers unreliable, inaccurate, and stale matter as World's Fair news. In our last issue we had occasion to expose one particularly flagrant instance of this kind, but this was by no means an isolated case. Repeated offences of this character have disgraced the columns of our contemporaries, and they will undoubtedly continue this practice as long as they can keep up the deception. The exposition has also brought to the front a class of projectors of journals purporting to be "specially devoted" to its interests, or to that of some particular department, but the inferiority of many of these publications is so apparent that even the use of the words "World's Fair" in the title will not save them from being estimated at their proper value.

As a matter of fact, it may as well be understood at the outset that journals published at a distance from the fair cannot hope to compete with those on the ground, and this is particularly true in the case of the electric journals. In order to make a showing or fill space our contemporaries have been obliged to resort to all sorts of schemes.

On the other hand, the WESTERN ELECTRICIAN, being on the ground and well equipped for the work, is prepared to furnish its readers reliable and accurate news from week to week, showing the progress of the work in the electrical department, which no other electrical journal can do. This it has done since the arrangements for the fair were begun, and it will continue to give the same excellent service until the close of the exposition.

PROF. S. P. THOMPSON, the dogmatic Englishman who conceived the idea that the rights of mankind to translate Gilbert's works rested in himself, seems to possess an especial antipathy to America and American inventions. He gave an evidence of this in the course of a lecture recently delivered in London, his subject being "Lamps." An abstract published in an English electrical paper represents that portion of the address devoted to incandescent lamps as principally given over to a studied belittlement of the work of Edison and a laudation of the efforts of Lane-Fox and Swan. This, perhaps, is not to be wondered at when Prof. Thompson's limitations are taken into consideration, but one anecdote that he gravely gives credence to is so absurd that it is difficult to believe that even Prof. Thompson could think it true. "The story runs," he says, "that an American financier entered the Western Union office where Edison was sitting, and flourished a $100,000 bill in his face, promising him it if he could 'subdivide the electric light.' Edison accepted, and a few weeks after informed his friends he had succeeded. His friends, through the cables, informed Europe, and gas shares dropped in a month from 200 to 140. The lamp that caused this scare was a platinum spiral, with a by-pass thrown in when the air expanded—little else but Groves' spiral." Englishmen as well as Americans will appreciate this when the statement is made that there was never a $100,000 bill in circulation in the United States. It would also be of interest to know the name of the gentleman who made such an offer. The story is of importance merely as an illustration of a regrettable tendency on the part of the lecturer to misrepresent the facts of recent history.

SEVERAL articles have lately appeared in the daily press expressing the idea that the introduction of electric heating will largely do away with the use of coal as fuel. The *Morning Advertiser* of New York, for instance, gives utterance to this fallacy in the following terms:

The coal barons are confronted by a problem which may become serious to them in the invasion of their bailiwick by electricity. It has been thought that natural gas was the cheapest and most perfect fuel for household use, but if the estimates of our electricians are not at fault—and so far they have not been caught tripping—the subtle current carried by the wire will soon relegate gas, as well as coal, to the coarser uses of the shop, locomotive and steamship.

Of course electricity generated for heating or for any other purpose must be produced at the cost of the expenditure of some other form of energy, such as the burning of coal or the force of falling water. As the latter form of power is hardly available for use in New York, it follows that if electric heating is to become a commercial phase of life in that city current will be supplied to consumers from central stations in which coal is burned under the boilers, precisely similar to existing plants for the supply of light and power. The conversion and transmission of heat by this process is not economical, and current from coal-burning stations in sufficient quantities for heating could only be used by the wealthy, to whom its convenience and cleanliness would commend it. It is apparent, however, that the "coal barons" would have nearly as much to say about the supply of fuel to such stations as to individual consumers at present, although it is probable that the mere cost of coal and labor would be proportionately reduced by the use of cheaper grades of fuel and by centralization. Doubtless electric heating has a great future, but at present it seems to be principally available in localities where water power can be utilized in the prime movers.

THE condition of the incandescent lamp litigation has improved greatly during the week, and the outlook at the present time is much more favorable than it was a week ago. The principal question, and in fact the most important consideration from the view point of the manufacturer of dynamos and the public generally, is, as has already been pointed out in this journal, the procuring of lamps. It seems reasonably certain that there will be no further trouble on this point. The decision of Judge Grosscup in the Chicago cases is generally interpreted as meaning that the General Electric company will be obliged to furnish incandescent lamps to all consumers in order to continue the injunctions secured against rival lamp makers. Another element has entered into this controversy, which bids fair to assume considerable importance. The Westinghouse lamps have been placed on the market; they are in actual operation, and, according to those who have employed them, they are giving satisfaction. While the company is not yet prepared to fill orders on short notice it expects to be in a position to do so within thirty days, and it has announced its readiness to supply lamps for manufacturers of other dynamos.

It is also reported that the General Electric company will not close up all of the rival lamp companies' factories and that arrangements have been made with some of the companies, including the Packard, to continue the manufacture and sale of lamps under a license.

One of the most interesting features of the litigation was the proceedings in Boston when the Beacon company interposed as a defense the plea that Edison was not entitled to a patent, asserting that Henry Goebel had really invented the incandescent lamp. This position was supported by thirty affidavits, but it is not probable that the court will sustain the claims of Goebel. A somewhat similar case is found in the telephone litigation, where the Drawbaugh claims were fortified by 145 affidavits of persons who claimed to have had knowledge of the invention of the telephone by Drawbaugh before Bell applied for his patent. Yet Drawbaugh's claims were thrown out and the Bell patent sustained. It is certainly a very late hour to undertake the overthrow of the Edison patent, but the proceeding at Boston had the effect of giving the Beacon company a respite, and further efforts to prolong the controversy may be expected.

ALTHOUGH electricity now plays an important role on great steamships, there is, beyond a doubt, a chance to extend its use profitably. This general statement, which is perhaps somewhat trite, is suggested by the recent disablement of the Umbria on her voyage from Liverpool to New York. Every one has read how the shaft was repaired under the direction of the able chief engineer, who determined to undertake the work although his assistants considered the job absolutely hopeless. Under the most adverse circumstances the shaft was repaired, and the ship was able to steam into New York harbor at half speed. It was a triumph of trained skill, wonderful patience and, perhaps, good luck. The fracture of the shaft was located at such a point that only five men could be employed at a time upon the repairs. Before the undertaking was completed and the shaft was allowed to revolve, it was necessary to drill in the aggregate 180 inches in the hardened steel. As the work was necessarily done by hand it was a slow and tedious task. The appliances on board that could be utilized were few in number and very simple in character, according to the statement of the chief engineer. It is not expected that a well equipped machine shop can be maintained on shipboard, and machine tools cannot be readily employed in the confined spaces where their use might prove desirable, but it seems to us that at least one addition could profitably be added to the meager stock of appliances now carried. An electric motor could readily be moved from point to point for supplying power where it might be needed. Its dimensions are so small that it could be located wherever a man could find room to work. All the large ships are now lighted by electricity, so that power is always available. In the case of repairs on the Umbria shaft a portable drill could easily have done the work of a dozen men, and have done it better. While delay apparently was not dangerous with the Umbria, still the utmost desire to complete the work was experienced even by the cool and level-headed chief engineer, who admitted that the engines were started before the fractured shaft was repaired as thoroughly as he wished. Every gain of an hour would have been worth more than the cost of a score of electric motors. While danger perhaps did not exist in this particular case it is easy to conceive of a situation where rapidity in the completion of repairs might be essential to the safety of a vessel. The value of an electric motor for furnishing power under such circumstances cannot be overestimated. The cost of a portable electric drill or of a suitable design of portable motor for furnishing power for the numerous mechanical operations now necessitating manual labor would be nominal, while its use in an emergency could be supervised by one or two men, leaving the other engineers free to attend to other necessary work. Such an equipment, in view of the umbria incident, should form a part of the store of tools on all the great steamers in which electric current is available.

The Year 1892 from a French Point of View.

In a recent number of *L'Industrie Electrique* E. Hospitalier gives a review of the year 1892. Following is a somewhat free translation of his interesting summary:

The year which has just ended has not been marked by any sensational discovery or by any remarkable invention, but it has none the less contributed its part toward the progress of electricity. In the domain of theory the splendid experiments of Tesla in England and in France have turned the attention of savants and investigators to alternating currents of high frequency as well as to electric waves, of which Dr. Hertz was the discoverer. In England the adoption of the C. G. S. system and the establishment of a plan of standards have demanded the attention of a special committee appointed by the board of trade and have provoked an important discussion before the British association. It is probable that the congress at Chicago will finish the work thus begun.

There has been no development in hydro-electric or thermo-electric generators of energy, and little that is new has appeared in continuous or alternating current dynamos, with the exception of the alternators of high frequency with periodic alternations of from 5,000 to 10,000 per second as compared with from 50 to 100 in the ordinary machines. The measurement of the elements of currents of high frequency constitutes a problem of which the solution must be looked for in the future.

Transformers have been the objects of extended and important studies, which have brought into prominence their characteristics in the different conditions of operation and the influence produced by the variation of any of the factors that enter into their operation. Efficiencies of 97 per cent. have been attained at full loads, which decrease to 90 per cent. at one eighth of the maximum load. This is perfection in the industrial aspect of the case, and whoever seeks to increase the efficiency throws away his time.

Accumulators are taking every day a more important place in the central station, because they meet the requirements at times of maximum consumption of current as well as supply a source of energy during the hours of little demand at night, when most of the lamps are turned off. A battery of accumulators weighing from 800 to 1,000 kilogrammes is now no uncommon thing, while a tenth of that weight was rarely exceeded a few years ago.

No new system of conduits has been added, but many facts of interest in this field have been developed. The knowledge thus gained has condemned the use of bare wires in tile ducts, in Paris at any rate, and has emphasized the dangers resulting from too close proximity of electric conduits and gas mains.

The distribution of electricity has achieved marked progress. The employment of potentials of 5,000 volts has taken a firm hold in actual practice, as in the Tivoli-Rome intallation; and the remembrance of the polyphase currents on the Lauffen-Heilbroun circuit leads us to the belief that the voltage will not stop at this figure.

As to applications, it is simply out of the question to try to compile a complete list. Central station managers are commencing to grasp the idea that they are not distributing light or power but electrical energy, and they are seeking, especially in America, to develop all the applications of which this energy is susceptible, for ventilating fans, elevators, pumps, machine tools, etc. It is a proper tendency, which we cannot encourage too strongly; means of the most improved description for meeting the various needs of consumers of power, who are, however, too often antagonistic to ideas of improvement and progress, are to be had for the asking.

Long distance transmission is to be accomplished by a number of important installations, and we await with a certain degree of impatience the results that will follow the utilization of part of the power of Niagara Falls. As far as can be determined from present experience long distance transmissions of power must be effected by alternating currents, simple or polyphase, while the distribution proper will be more advantageously accomplished with continuous currents. The transformation of simple or polyphase alternating currents into continuous currents, on the plan followed by Hutin and Leblanc during the whole of 1892, is to-day practically accomplished, and the year just beginning will gain the benefit of the system.

Electric traction continues its onward march in America, and old Europe lags far behind, but is beginning to realize the advantages of this means of transit. Several roads have been built and a number of others are in course of construction, which enables us to forecast the future of the industry.

If we can recall no salient fact in telegraphy in general, it is still true that our patriotism is stirred when we note the progress of submarine telegraphy in France, for the year 1892 marks the epoch of our freedom from England in the matter of making and laying great ocean cables.

In telephony we have only to note the completion of the buildings of the great exchange in Paris and the construction of the long distance telephone line from New York to Chicago, a distance of about 1,000 miles.

Such is the balance sheet, modest on the whole, of the year 1892. That of 1893 has surprises in store for us, perhaps even wonders!

Incandescent Lamp Litigation.

As announced in the last issue of the WESTERN ELECTRICIAN the progress of the litigation conducted under direction of the General Electric company against rival incandescent lamp makers received a check at Boston when the Beacon company presented affidavits upon which it based its claim that Mr. Edison was not entitled to a patent upon the incandescent lamp. The claims of the Beacon company were considered of sufficient importance by the court to postpone the granting of a restraining order until the affidavits and briefs were printed and submitted for examination. Concerning the claim which Goebel makes S. B. Eaton, a legal representative of the Edison interests, is reported in the New York *Evening Post* as saying:

This invention of Henry Goebel and his claim to anticipate Mr. Edison were brought to our attention in May, 1882. Goebel's representative at that time had his dealings with me as a representative of the Edison companies. This representative of Goebel was one of the most prominent patent lawyers in the United States, himself a man of wealth, and able to command among his friends and clients any amount of money to back up a good invention. He wanted the Edison company to buy what Goebel had. I laid the matter before the board of directors of the Edison company. The matter was then investigated under their direction, and the result was that we decided not to buy at any price. We did not even go so far as to discuss terms with the Goebel people. What Goebel had was absolutely worthless. All this appears at length in the minute book of the Edison company and my own personal diary, in and about the month of May, 1882. My understanding is that this prominent patent lawyer who then acted for Goebel took the same view of the subject that we did, and dropped it.

The case of the National Electrical Construction company of Chicago occupied considerable time in the United States court last week. It will be remembered that this company asked permission to buy incandescent lamps, asserting that the Chicago Edison company had refused to sell. Judge Grosscup instructed the plaintiff to make out a list of the number of lamps required and present it to the Chicago Edison company together with the money. The court fixed the price at 42 cents per lamp. The Edison company finally accepted the order. This proceeding is considered a victory by the General Electric company's rivals, as it is taken as an indication that it will be compelled to supply lamps to all consumers in order to prevent the removal of the injunctions on rival lamp making concerns.

Chicago City Electrical Department.

City Electrician Barrett will present some interesting data in his annual report of the electrical department of Chicago. During the last year 5,046 arc lamps and 101,668 incandescent lights were inspected by this department. There were also 504 motors and 345 generators inspected, and wiring installations for 188 motors to be placed in position were also passed upon. At the same time 2,082 arc lamps and 30,998 incandescent lights were reinspected. Following is a statement of the yearly inspections of electric lamps from February 14, 1884, to January 1, 1893:

Year.	No. of Arc.	No. of Incand'sc't.	Total Wiring Mi.	Feet.
1884	1,148	1,885		
1885	329	7,609		
1886	479	5,225		
1887	837	5,424		
1888	2,369	17,717		
1889	2,623	24,966		
1890	2,682	33,543		
1891	3,974	87,913		
1892	5,046	101,668	1,001	1,828
Total	19,487	291,950	1,001	1,828

Chicago and St. Louis Electric Railroad.

A St. Louis dispatch dated January 30th states that the contract for the construction of the Chicago and St. Louis Electric railway roadbed has been let. The agreements are said to have been signed, sealed and placed on deposit with a trust company in St. Louis, and are for the complete construction of the road and the furnishing of all material, iron, ties, etc. Contracts have been let to Dagnell Bros. of St. Louis, and Givens Bros. of Memphis, but it is impossible to learn the exact figures. It is known, however, that each firm is to receive as part payment for its work $2,000,000 in the stock of the road.

First Three Phase System of Distribution in the United States.

By A. B. C[illegible]

Probably no development in the electrical world [illegible] caused more comment and interest than did the great three phase system of power distribution at Frankfort [illegible] year. Much has been done in this country to make a practical demonstration of its usefulness, and it is in Concord, N. H., that the first central station for power distribution by the three phase system will be started.

Two 250 kilowatt generators will be used at the start, the initial potential will be 2,500 volts, which will be reduced to 250 volts at motors of which 700 horse power are already contracted for in small units.

The Concord Land & Water Power company, which is developing 5,000 horse power at Sewalls Falls in the Merrimack, will have this model plant in operation early this spring. The power plant of the company will consist of five 400 horse power horizontal turbine wheels, which will drive pulleys on a short hollow shafting through which the main shaft runs. The dynamos will be driven in the same manner, suitable clutches being used to enable one or all of the wheels to drive one or all of the dynamos, thus reducing danger of any serious breakdown.

The dynamo room will contain the two 250 kilowatt 3 phase generators, two 2,000 light alternating dynamos and five 50 light arc dynamos.

The ultimate capacity of the plant will be just double this number. The company will have in addition about 3,000 horse power to dispose of to any manufacturing concern that will locate at or near the falls. It now has a ten year contract for lighting the city and 6,000 incandescent lamps under contract.

All the wires from the station to the city limits will run in a straight line along the right of way which the company owns, and will be bare copper. The line will probably contain 40 wires.

The entire installation was designed and is being put in by Eugene F. Carpenter, electrical engineer and superintendent for the company. The entire equipment will be furnished by the General Electric company.

Blaine's Last Public Appearance.

It is a noteworthy fact that the last appearance of the late James G. Blaine in a public capacity at Washington was before the senate commerce committee last session, to oppose a bill that provided for granting valuable franchises to a French cable company. A Washington correspondent thus describes the event: Mr. Blaine's powers of mind and body had been failing then, and the fact had been remarked by some of his friends, but on this occasion he seemed to feel the life and fire of youth, and his address to the committee was characterized by the clearness of thought, penetration, energy and vigor of the Blaine of old. The subject before the committee was a bill to grant a French company authority to lay a cable from the United States to San Domingo. The government of Brazil had given to this company the monopoly of the right to lay a cable through Brazilian territory to the West Indies, where it was to connect with a cable from France. Attached to the Braziliao grant was a condition that the cable company should secure cable connections with the United States, Brazil being anxious to have direct communication with this country. In order to comply with this condition a new and auxiliary corporation to the original French company was organized. It came to the government of the United States for a permission to lay a cable from Charleston or Port Royal to San Domingo, where it was to connect with the cable from Brazil. Mr. Blaine, as secretary of state, declined in the name of the president to grant the privilege requested unless the company would agree to waive its monopoly rights in Brazil in favor of any American company which might wish to lay a cable. The company claimed that it was impossible to agree to such a thing; that it only wanted to lay a cable to San Domingo and had no control over the other company, whose line ran to Brazil. Mr. Blaine considered this to be a subterfuge and insisted that no cable should be laid until the Brazilian government should grant permission to any cable company the same rights as were accorded the French company. An attempt was then made to get from congress what Mr. Blaine had denied, and a bill granting the necessary permission to lay a cable in territory of the United States was introduced. When the bill came up for a hearing before the committee on commerce, of which Senator Frye is chairman, Jeff Chandler appeared in behalf of the company. Mr. Blaine replied, and astonished the committee by the animation he displayed. He carried his point, and by a unanimous vote the committee coincided with the position taken by Mr. Blaine.

World's Electrical Congress.

At the last meeting of the advisory council of the World's Electrical Congress the chairman was authorized to appoint four committees to take up the work of arranging the details for the meeting in Chicago on August 21st. Prof. Gray has made his selections, and has announced the following appointments:

Executive committee—Prof. Elihu Thomson, Enos. M. Barton, G. M. Phelps, F. S. Terry and Prof. B. F. Thomas

Finance committee—B. E. Sunny, Prof. E. J. Houston and W. A. Kreidler.

Programme and Papers Committee—Prof. H. A. Rowland, Prof. H. S. Carhart, Carl Hering, A. E. Kennelly, Prof. W. A. Anthony, Prof. F. B. Crocker, Prof. E. L. Nichols and Prof. T. C. Mendenhall.

Invitations committee—T. C. Martin, Dr. Louis Duncan, Prof. C. R. Cross, T. D. Lockwood, and C. H. Wilmerding.

Prof. Gray is a member of each of these committees, *ex officio*. He will participate in the work of each. It is proposed to establish headquarters for the congress at Chicago at an early date, at which R. W. Pope will probably be stationed to look after the detail work in conjunction with Prof. H. S. Carhart, the secretary.

National Electric Light Association.

The St. Louis Electric club is actively engaged in preparing for the entertainment of the members of the National Electric Light association and visitors to the convention which will be held in that city shortly. At a recent meeting of the club financial and executive committees were appointed J. A. J. Shultz was appointed chairman of the finance committee, and with him were associated James I. Ayer, E. D. W. Meier, George P. Jones, T. M. Ambler, Louis Nahm, C. R. Scudder, Robert B. Annan, Marcus Bernheimer, John S. Moffitt, Frank R. O'Neill, F. J. Wade, L. D. Kingsland, Frank Shapleigh, Frank Gaiennie, Goodman King, Ben Eiseman, Douglass Cook, Ellis Wainwright, A. Seigel, S. G. Booker, John C. Wilkinson. The executive committee was named as follows: Louis Nahm, chairman; James I. Ayer, Frank Gaiennie, Nathan Frank and Goodman King.

More News from the Coast.

Terrence Duffy, of San Francisco, manufacturer of rustic work, has been investigating "Nature's Law," etc. He has gone into the subject to such depth, says the *Pacific Electrician*, and his learning has become so profound, that when he talks nobody knows what he says, except one friend, and that friend is not certain. Being anxious to show "where he is at." Terrence has written a book and published it himself. It is partly called "From Darkness to Light; or Duffy's Compendiums of Nature's Law, Forces and Mind Combined in One, Conformable to This, His Great Discovery, That the Sun and Earth Are the Poles of the Magnet." The rest of the title we are precluded from printing on account of lack of space. The *Chronicle* says that the book is no joke, Mr. Duffy being really in earnest, but thinks that the author is not always clear in the expression of his peculiar views of magnetism, electricity, space, vibration, tension, etc. As for example, when he says: "Now, space being filled with tension or pull, we place a conductor or copper wire to utilize this electricity or magnetic pull. The copper, being non-magnetic, makes a hole in space, and we send what we call a current through it. The wire forms a circuit through space." And also: "A degree of heat raises a degree of cold. The cold is inert and dead. The heat raises the cold, and gives it motion or circulation. The heat gives the cold life by forcing it to move."

We fear that there are very few persons this side of Stockton who will be able to comprehend Mr. Duffy's ideas. Possibly Alvin D. Brock might be induced to explain them. Mr. Brock is the celebrated thinker who wrote an article in *Overland*, telling in glowing terms how a certain James A. Christy was going to revolutionize the world with mysterious electrical forces which he had discovered, and which nobody but Christy and Brock understood. Mr. Duffy is evidently the philosopher of the growing group of great electricians that the coast is producing. Mud-battery Tichener, Christy, Crouch of harmless dynamo fame, and one or two more whom we "have upon the list," and will soon make known to the world, constitute the leading members of the group. Mr. Brock is the one who knows what they mean.

New Mining Hoist.

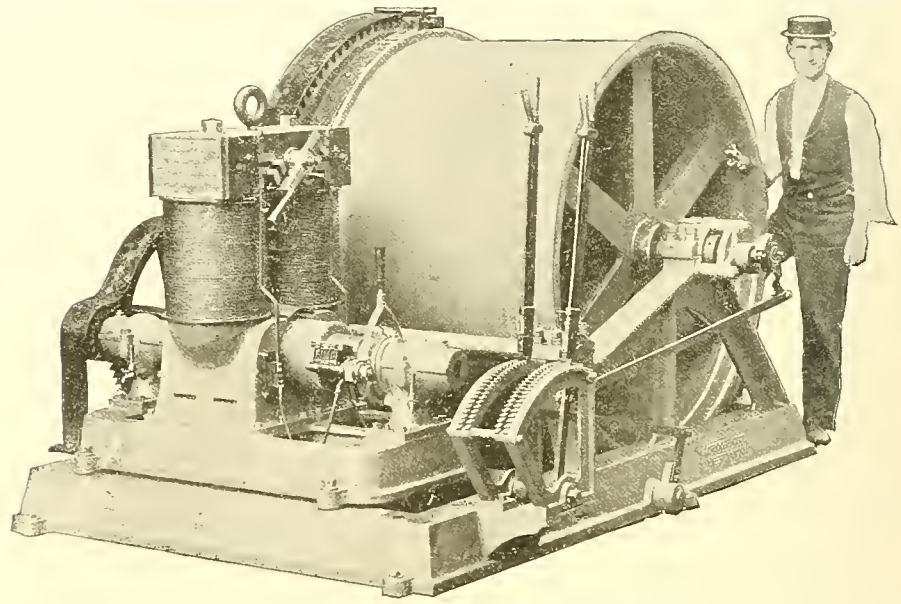
A new electrical mining hoist has been recently brought out by the General Electric company. It is constructed with the especial object of obtaining a wide range of hoisting speed. The drum is of unusually large diameter, and is connected by an intermediate gear to the armature shaft of a 25 kilowatt motor of the General Electric company's regular bi-polar type. The controller for the motor, which is not shown in the cut, is similar to that used in street railway service, and is erected on a separate support conveniently within reach of the operator and directly to the right of the levers. These can then be operated with the left hand, and the controlling switch with the right. The series method of electrical control is adopted, the speed being increased or decreased to meet requirements by the movement of the switch handle. The hand brake is of the band type, lined with wood, and extends almost entirely around the drum. The drum is thrown into operation by a clutch operated by the second lever. The range of speed obtained on this hoist is very wide. It is designed to raise loads of 1,300 pounds at a rate of 600 feet a minute, and has successfully accomplished this. It can also raise loads of 100 pounds at a speed not exceeding 20 to 30 feet a minute. The motor is erected on its own bed plate, which is in turn bolted to the bed plate of the hoist proper, the whole apparatus occupying comparatively little space.

Electrical Recording Meters.

By Caryl D. Haskins.

Part II.

The general character of the clock meter has already been briefly stated; that is, we have already defined the character of one form of clock meter. There is almost endless variety of instruments of this kind. They are not all electricity meters by any means; some are recording voltmeters, others recording ammeters, and others have still different purposes. The familiar recording steam gauge is only a modification of this instrument. Many such instruments have been designed for station work and for testing purposes, where great accuracy and considerable cost of construction was permissible. But the e hardly come within the province of a treatise of this kind.



NEW MINING HOIST.

A paper is almost invariably rotated over a drum, sometimes being fixed to the drum, and sometimes being drawn from one drum to another, the paper moving at uniform speed, and generally being divided into hours or other fractions of time by abscissæ lines.

This clock mechanism can be combined with any indicating device; it is only necessary to supply the connection which shall cause the indicator to mark the paper, and draw a crooked line. First attempts of this kind are generally made with an ordinary solenoid, or sometimes with a simple coil and iron core rising and falling with the current. Whatever the character of the indicator or method of communication between the indicator and paper, it remained necessary to keep the friction of contact low.

First attempts were made with a pencil, bearing directly upon the paper, but the friction introduced by this device was fatal to accuracy, A glass pen has been substituted for the pencil with better results, but even this caused too much friction. The photographic method of line drawing is one of the best systems yet introduced, and is probably more familiar to the majority of us than the other methods, because it forms a component part of the Walker meter, which has attracted attention at various times.

With an instrument of this kind a diaphragm is provided, attached to the indicating mechanism, and raising and falling with the variations of the indicator. Through this diaphragm is a small aperture, the best plan being to form this aperture by the crossing of two slits in two diaphragms. Through this small hole, light from a burning lamp is shed upon sensitized paper with the result already described.

One of the best methods of accomplishing the registration, perhaps, when all things are considered, the very best, is to attach to the pointer of the indicator a steel point or needle with an iron armature mounted in the form of a spring, or in some similar manner. By placing an electro-magnet behind the paper to be marked, and sending through this magnet an electrical impulse at fixed periods of say, one, two or five minutes, the pointer is drawn sharply down to the paper, puncturing it, and is immediately released by the cessation of energizing current in the electro-magnet. Thus the paper when removed will have a continuous marking of punctures tantamount to a curved line. This device presents practically no friction, and is more or less simple and easy to carry out. The make-and-break necessary for the electro-magnet is easily actuated by the clock movements. But we may say of these forms, as well as of the forms of clock meter which are to follow, that there is one serious objection to them all—they have to be wound up, which is certainly a fault. We may modify this statement by saying that many o these devices have an electrical attachment which makes them self-winding, and this is a step in the right direction at least. Whether it fully meets commercial necessities is, I believe, an open question.

All of these instruments being curve-drawing meters, they cannot properly be considered as the thoroughly commercial article, which the successful electric meter must be. For I think I am safe in assuming that, to be successful, the meter of to-day positively must have a direct reading dial, equally available for the consumer and supplier.

This brings us to a second form of clock meter of a preferable character. This class comprises those meters whose clock mechanism is accelerated or retarded by the strength of the current passing through them. There are several methods of accomplishing this, all of which apply the influence of the current to the pendulum of the clock.

For example, we have a pendulum with an iron end forming an armature which is attracted first to the right and then to the left by two electro-magnets dependent for their strength upon the lamp circuits. This is an early and very ineffective form of clock meter, hardly to be considered as a practical affair, but typical of the class.

The most successful, and probably the best form of meter of this kind, consists of two clocks with a differential gear between. One of these clocks runs at a constant speed, the speed of the other being governed by the circuit to be measured. At times, by a shunt pressure coil forming an armature and a fixed series coil forming a field, or again, by a horse shoe magnet pendent from the pendulum and vibrating back and forth above two coils in series with the lamps, the former being a watt meter and the latter an ammeter. Both were designed by the same inventor. When nothing is passing through the meter the speed of both clocks is the same, and the differential gear does not move; but when lamps are turned on and the regulating device begins to act, one clock is accelerated or retarded according as the principle may be applied, and the difference between the constant speed clock and the varying speed clock indicates the consumption in directly read units.

I can safely say that this is an excellent meter, but is obviously open to the same objections as are other clock meters, since there are two clocks, and the presence of the differential gear requires very nice adjustment between the two. There is another important factor here, which bears directly upon the question in hand, and that is the cost of building meters of this class. The clock-work must not be of a cheap character, but must be good clock-work, and good clock-work is invariably expensive, and is invariably delicate.

I might say, however, that the Aron meter, the typical meter of this type, proved itself so accurate at the recent meter competition in Paris that it succeeded in dividing the first prize of 10,000 francs and a gold medal with the Thomson recording watt-meter. Your attention may be directed to the fact that the Aron meter is a watt hour indicator, something unusual, for almost everything considered up to the present point has been typically an ammeter or a modification of an ammeter.

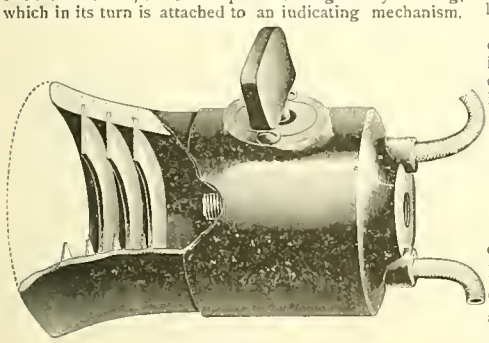
Before turning to the final portion of this paper and considering the most popular and as yet the most successful class of recording instrument, viz., the motor meters, a little attention should be given to those clock meters whose principle is dependent upon the function of a cone or cones.

Briefly, the principle of all of these instruments is about as follows: Let us assume a wheel rotating at a constant speed; let us assume a cone mounted on a shaft on which it is free to rise and fall; let the cone rise and fall with one of its sides in a vertical plane with the periphery of a constantly rotating wheel; the speed of the cone regulates the speed of rotation of the recording gear, and the position of

the cone is determined by an indicator device which obviously must be of high torque, because friction must be a more or less serious factor. Some very fair instruments of this class have appeared from time to time. One of the most ingenious of them provides two cones, or rather two cone-like drums, somewhat like a beehive in shape. One of these cones is rotated at a constant speed, and the other is inclined on a movable right angle axis in such a way that its point of contact with the neighboring cone varies with the load; the same end being accomplished as that in the rising and falling cone just described without the introduction of as much friction. This is a type of the Maxim meter.

Another similar device provides for a small wheel rising and falling between two cones whose inner sides are parallel, thus transferring the power from a constantly-rotating cone to a cone with varying speed, the same object and end being accomplished in all cases, and invariably involving friction.

Another form of cone meter, still a clock meter, differs somewhat from those just described. Let us assume a conical drum, shaped like the bullet of an ordinary rifle, and some four or six inches in diameter at the qase, rotating at a constant speed by a clock mechanism heneath it; let us suppose a spool of thread to be placed upon a pin a foot or so removed from the drum; the thread from the spool is attached to the drum, which should be covered by some felt-like material; the thread passes through an eye or ring, which in its turn is attached to an indicating mechanism.



CUTTER'S MINE SOCKET.

It is apparent that the indicator will raise and lower the spring according to the amount of current or energy passing. Since the drum rotates at a regular speed, the thread will be wound onto the drum, and the point where it is wound will depend on the position of the indicator. Thus, if the load were very small, the indicator would be at its highest point and the thread would be wound around the smallest diameter of the drum. As the load increased the indicator would be depressed and the thread would be wound on a greater diameter of the drum. The inspector of meters, on his monthly visit, would remove the thread which had been wound onto the drum, measure it on a yard stick, and ascertain perhaps that the consumer had used 15 yards of electricity. This is certainly reducing things to a very practical standpoint.

In conclusion, I would say of the clock meters, that those which actuate a drum or marking mechanism, and those akin to them, generally have a stopping and starting device which prevents the clock from running at times when there is no current passing through the meter; this is quite essential. Those which have a lamp within them for photographically marking the fluctuations of current have an automatic cut-out for the lamp, which turns on

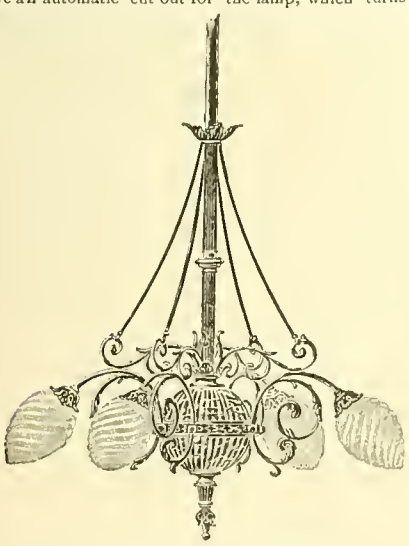
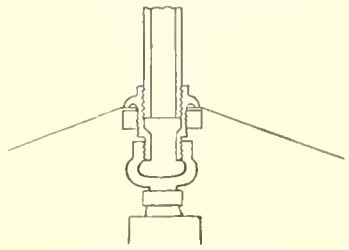


FIG. 1. ELECTRICAL FIXTURES.

the light in the meter when the last lamp on the supplied circuit goes out. I might add that in a few of these meters the clock is displaced by a constant speed motor.

There is one other class of clock meters which actuates a dial or recording train, and for the typical instrument of this class we will select the Pilkington-White meter. This instrument has a wheel rotating at a constant speed; into this wheel are inserted a number of pins of different lengths, projected from the face of the wheel parallel to its axis; a lever arm whose position is determined by the indicator mechanism is so placed that it shall engage with these pins. If the load be light it will only engage with the longest pins. If, for example, the load be one lamp, then the lever will engage only with the longest pin. On engaging with the pin, the lever is pushed in the direction in which the wheel is rotating, and gives an impulse of one tooth to the recording wheel. Thus, on the light loads the meter would receive but one impulse for every revolution of the motor wheel, and just in proportion as the load



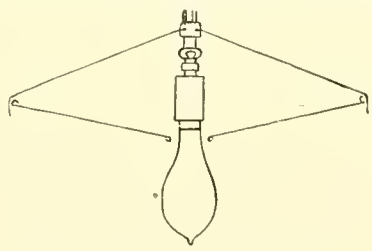
MARTEN'S SEAMLESS HOOD.

increased, so this lever would engage with more pins and more frequently actuate the recording dial.

This meter is very good in many respects; but it should be noted that it reads to points. There is necessarily a limit to the number of pins which can be used, and with a 100-light meter, having, we will assume, 10 pins, it is clear that there can only be 10 variations in speed from one lamp to full load, consequently the speed will only change every 10 lamps, and we should get the same record on 19 lamps as on 10. The figures which I give for a 100-light meter and 10 pins, are purely arbitrary and not representative of the number used, but are given to indicate the idea which I wish to convey.

Electrical Fixtures.

The electrical fixtures herewith illustrated were designed especially for the New Jersey Lamp & Bronze company of New Brunswick, N. J. This company confines itself exclusively to the manufacture of electrical fixtures. In the accompanying cuts, Fig. 1 shows a center chandelier, designed by C. McKnight Smith, who is connected with the New Brunswick factory. Fig. 2 shows a chandelier designed by an eminent Italian artist. The company has several promising designers and is constantly bringing out new devices. G. Wilfred Pearce, who is in charge of



MARTEN'S SEAMLESS HOOD.

the company's factories, is well known to the trade. He was identified with the Edison interests for many years and is thoroughly equipped for his work.

The New Jersey Lamp & Bronze company will make an exhibit at the World's Fair, and it is now preparing a special line of fixtures for this display.

Cutter's Mine Socket.

The new mine socket developed by George Cutter which is illustrated herewith is said to be absolutely water proof. The key socket has a well-built interior, with porcelain insulations, protected by a casing of polished hard rubber. The leading-in wires are cemented into the shell, while the handle or key passes through a series of water-tight bushings. Then there are a set of soft rubber rings which press against the bulb of the lamp when screwed into place, and prevent any moisture from reaching the lamp base. Cutter's mine socket is made either with or without key, and when intended for use in mines it is fitted with a prong-hook which allows it to be supported in any convenient position. It is made by George Cutter of Chicago.

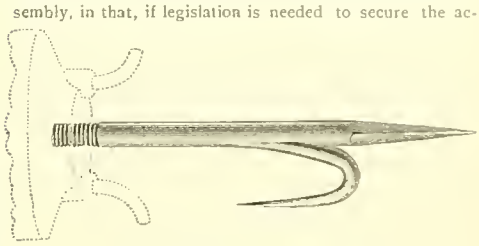
Marten's Seamless Hood.

A. S. Marten, President of the Tea Tray company, of Newark, N. J., is the inventor of the new seamless hood which is herewith illustrated. This hood is thoroughly coated with a special elastic preparation which gives it a highly polished surface. The reflector is also coated with a white enamel. The hood and reflector are so adjusted that the receptacle is protected from the weather. All parts of this device are interchangeable. There is no danger in the breaking of the hoods by ordinary use, as they are made to stand any strain. Reflectors are made to fit a protection globe if required. The hoods are made so as to take wires from the inside or outside as may be desired. This hood is attractive in appearance and durable.

CORRESPONDENCE.

New York Notes.

NEW YORK, January 25.—This city is threatened with another legislative investigating committee, and the Rapid Transit commission is the particular object against which the proceedings are directed. Resolutions have been presented in the assembly in which serious charges are preferred against the commissioners. It is alleged that the plan submitted was impracticable, and that the commissioners reported it because they felt that the commission would be unable to induce capitalists to invest in the scheme. This method was adopted according to the resolutions in order to secure the Manhattan company a continuance of its present monopoly on rapid transit facilities. The resolutions provide that a special committee of five members of the assembly be appointed by the speaker with power to subpœna witnesses, send for books and papers, employ counsel and stenographers, to investigate the action of the Rapid Transit commission in adopting the plan of rapid transit and all actions and proceedings connected therewith, and to report the findings to the assembly, in that, if legislation is needed to secure the ac-



CUTTER'S MINE SOCKET.

ceptance of a practical and satisfactory plan of rapid transit for the city, it can be had at the present session of the legislature.

The resolutions were referred to the committee on ways and means and will prohably remain there unless the members of the commission insist upon an investigation. This is hardly necessary, however, as it is generally admitted that the gentlemen composing the commissinn do not need an official recommendation in order to satisfy the people of the city of their integrity. They have labored zealously in the interest of the community, but they have been unable to cope with the tremendous influence of the great "L" road, which has, of course, been opposed to their plans.

The Chadwick Civic club has issued a call for a conference of workingmen to be held in Clarendon hall, February 3rd, for the purpose of deciding on "effective measures for preventing additional concessions to the Manhattan railway monopoly, and to further the construction and operation by the city of a real rapid transit system, like the one planned by the Rapid Transit commission." Many labor

FIG. 2. ELECTRICAL FIXTURES.

unions have already pledged their support to the movement, and it is expected that every union in the city will be "in line" before the time of the conference.

In the meantime the Rapid Transit commissioners have sent a letter to the Manhattan company in which they call attention to the fact that the resolutions adopted January 17th provided that an application from the Manhattan Railway company for the acquisition of additional facilities

would only be considered upon the following among other conditions:

"That the elevated railway system shall he so extended within a reasonable time, to be prescribed, as to transport passengers between the Battery and the northern limits of the city, upon both the east and the west sides, at a single maximum fare of five cents."

It is further explained that the commission does not understand the application sent to them on the 20th inst. to be in compliance with this condition, and it prefers that the application shall be made to comply with this condition before the matter proceeds to a hearing.

The board of electrical control on Wednesday adopted a resolution directing the engineer to report a district below Fifty-ninth street, east or west, in which the poles can be taken down and subways built. The board granted permits to the Metropolitan Telephone company, Mt. Morris, Edison, Manhattan, and Harlem Electric Lighting companies, and the Empire Subway company to build subways in about one hundred and fifty streets below Eightieth street. It was decided to permit no subways to be built in newly paved streets, and the companies were informed that if they desired subways in the streets which have been designated to be repaved, they must be active.

W. F. O.

Northwestern Notations.

MINNEAPOLIS, January 28.—A bill has been introduced in the Minnesota legislature limiting the charges for telephones to $3 per month and $2.50 where more than one instrument is used. The telephone companies throughout the state are exerting every influence to secure the defeat of the bill. One representative of the telephone interests, Manager Sherman of the Stillwater, Minn., telephone exchange, is circulating a petition against the proposed legislation, and it is said that only five of the company's patrons refused to sign.

It is proposed to extend the St. Paul electric system to the stock yards at South St. Paul.

Marshfield, Wis., advertises for bids for lighting the city with electricity. Bids will be received till March 2d.

Duluth is now figuring on securing the removal to that point of the Peoria, Ill., Electric company's plant for the manufacture of dynamos, motors and generators. The Phœnix Electric company is back of the movement and proposes to increase its capital to $250,000.

The electric light companies in St. Paul are making a vigorous protest against the proposed ordinance requiring them to put switches in every block for shutting off current in case of fire. They claim it would entail needless expense.

The Spearfish, S. D., Electric Light & Power company has completed its incorporation with $500,000 capital and is preparing to proceed to the erection of an extensive plant as soon as the council gives a franchise.

In the franchise which was given the Grand Forks, N. D., Electric Street Railway company it was stipulated that a mile of track should be in operation by February 2, 1893. The company has done nothing but run levels for grading. A local newspaper says this confirms the theory that the charter was secured for purely speculative purposes. If an extension of time is asked for there will probably be much opposition. It is claimed there are citizens of Grand Forks ready to invest their money in such an enterprise.

The St. Paul board of education has approved a contract with the Edison Electric Light & Power company for heating and lighting the high school building for five years. The company is to get $4,600 per year the first two years, $4,000 the third, and $3,600 the fourth and fifth years, and furnish all pipes, making connections with its plant a few blocks distant.

The report of the receiver of the Stillwater, Minn., Electric Street Railway company for November and December shows receipts in November, $2,372.37, disbursements, $1,355.07; in December, receipts, $2,040, expenses, $1,343.64.

The Water, Light & Power company of Superior, Wis., has secured an excellent site for the extensive plant which it proposes to put up at once. The property covers 192 by 160 feet at the corner of Second street and Hughitt avenue.

Representative Ives has introduced a bill in the Minnesota legislature extending the right of eminent domain now enjoyed by railroad, telegraph and other companies to electric light and power companies. The committee on corporations has recommended it to pass.

It is reported that a new telephone exchange will be put in at La Crosse, Wis., using the Fred H. Brown patent.

A bill has been introduced in the Minnesota legislature requiring street railway companies to enclose the front and rear platforms during December January, February and March.

It is reported that the Duluth Street Railway company has practically secured a controlling interest in the stock of the Douglas County Street Railway company of Superior. A re-organization is proposed.

Judgment has been ordered in the petition of the Edison Electric Light & Power company of Minneapolis for a dissolution of the corporation and the sale of the property.

The Edison Electric Light & Power company of St. Paul has elected these officers for 1893: Kenneth Clark, president; Thomas B. Scott, vice president; G. H. Finn, secretary and treasurer; directors, Kenneth Clark, F. A. Seymour, E. C. Long, T. B. Scott, R. M. Newport, George H. Finn.

H. C. C.

Washington, D. C.

WASHINGTON, January 28.—The stockholders of the Baltimore & Washington Turnpike Tramway company, which is to build the proposed electric road and boulevard between Washington and Baltimore, held a meeting in Baltimore last week. The present board of directors represents the traction syndicate of Philadelphia, New York and Baltimore. The route now selected will leave Baltimore by Wilkins avenue, cross the Baltimore & Ohio railroad about Elkridge Landing, follow north and west over the Washington turnpike, pass through Laurel and Hyattsville, enter the city about Eighth street and Rhode Island avenue northeast and connect with the Eckington electric railway at Eckington. The Baltimore power house is now in course of erection. The Philadelphia Traction company has the large controlling interest, although the New York and Baltimore Traction companies are also in the undertaking.

Washington is to have another electric street railway at an early day, provided the charter can be obtained from Congress. The proposed site will be on a leading thoroughfare in the northwest section to Tennallytown. The company is formed.

The annual election of directors of the Washington & Georgetown Railroad company was held last week with the following result: Henry Hurt, John G. Parke, William R. Riley, John R. McLean, A. H. Lowrey, Robert Beall and G. T. Dunlap.

The directors of the Eckington & Soldiers' Home Railway company were also elected last week as follows: Henry L. Crawford, C. C. Duncanson, E. Kurtz Johnson, John H. Lane, Joseph Paul, Lorin M. Saunders, Thomas Summerville, George Truesdale and B. H. Warner.

The board of directors elected last week for the Georgetown & Tennallytown Railway company is composed of John E. Beall, Spencer Wilkins, F. G. Newlands, James B. Henderson, J. Hite Miller, M. Wilson Offutt, Edward P. Watkins, Robert D. Weaver and John C. Davidson.

At the meeting of the United States Electric Lighting company held last week encouraging reports were made by the officers of the institution, showing that last year there had been an increase in the business of the company of 85 per cent., and in the ten years since Capt. A. A. Thomas has been at its head an increase of 94 per cent. Last year it was found necessary to increase the size of the works by duplicating the plant. Work will be commenced immediately, and an office building will be erected too. A week ago the stockholders elected the following board of directors: A. A. Thomas, W. E. Clarke, S. W. Tullock, A. M. Renshaw, Robert Boyd, G. W. Pearson, D. B. Clarke, C. C. Duncanson, John Paul Jones, Emmons S. Smith, P. Hill. These gentlemen organized by re-electing Captain Thomas president; S. W. Tullock secretary and treasurer; A. M. Renshaw general manager, and adding W. E. Clarke and Robert Boyd as first and second vice-presidents respectively.

Superintendent Kimball of the life saving service has been officially informed that the United States government telegraph and telephone line between Assateague and Cape Charles, Va., a distance of ninety miles, has been completed and has been formally put into operation. This line supplies a connecting link to lines that run at either end to Cape Henlopen and Lewes, Del., making a complete line 165 miles long, along the most dangerous coast of the Atlantic. The line was constructed by the life-saving service at an expense of $12,500, and includes twelve miles of submarine cable. Superintendent Kimball says that it is the cheapest line of the same quality ever constructed. Congress appropriated for it $15,500, and $3,000 remains unexpended. Its value to shipping and to the people of the country through which it runs is very great, bringing as it does this section in close communication by wire with New York and other large seaport cities, enabling tugs to be sent to wrecks to save cargoes, etc., and putting seventeen life saving stations on the line into communication. W. Easby Smith has been appointed superintendent of the line, which was erected under the direction of William Bolton, an expert of the life-saving service. The line will be operated by the employes of the service without entailing additional expense.

The commissioners will return to Congress the bills to incorporate the East End Electric Railway company of the District of Columbia and the Washington & Marlboro' Electric Railway company of the District of Columbia, recommending that charters be granted these roads under the usual conditions. It is recommended that inasmuch as both these roads desire to cross the eastern branch, together with the East Washington Crosstown Railway company, the charter of which is now pending in Congress, they be required to build a bridge across the eastern branch along the line of E street east extended. In case of the East End Electric Railway company the commissioners suggest that the route be changed so as to go up Tenth street east to B street, north to Twelfth street east, instead of passing around Lincoln square, as is now proposed.

George Truesdale, president of the Eckington Railway company, has sent to the district commissioners a letter in which he asks their favorable consideration of the Senate and House bills to amend the charter of the road. The bills ask that the railway company be granted the privilege of maintaining its overhead trolley wires on New York avenue for two years. The reasons urged for asking this extension are that to make the change now, in view of present complications, would cripple the company. These complications are due to litigation over the storage battery patent now in use by this road. The company wishes to equip its extensions with a storage battery system, which, it is alleged, will be expensive, and thinks it would be a hardship to be compelled to tear down the wires on New York avenue.

By request Mr. Wilson has introduced in the Senate a bill to incorporate the Chesapeake & Washington Underground Electric Railway company. The incorporators are Henry Carey of New York, J. Luthell Murphy of California, John I. Parsons of Virginia, George W. Tibbetts the state of Washington, and W. K. Mendenhall, J. W. Parsons and Woodbury Wheeler of the District of Columbia. The route to be taken begins at the intersection of B street north with Third street west, runs thence along B street north to Thirtieth street and Pennsylvania avenue, thence in a generally easterly direction along the Benning's bridge across the Anacostia or eastern branch of the Potomac to the southeastern boundary of the District. Whenever the territory traversed is given a system of permanent streets and highways, the company shall change the line to conform to them. The motive power must be electricity, and the wires must be laid underground. The capital stock is fixed at $25,000 a mile. The incorporators shall organize the company within ninety days after the passage of the act.

G. M. P.

New England News.

BOSTON, MASS., January 28.—There is considerable legislation pending in which electrical interests are involved. The committee on rapid transit of the Massachusetts legislature has decided to hold hearings on the memorials to congress which were adopted by the rapid transit commission of last year asking for authority to construct an elevated railroad bridge over the Fort Point channel. It will also give hearings on the matter of rapid transit considered as a whole. Several members of the committee are in favor of the construction of one broad avenue through the city and a tunnel under the common.

Representative Hoar, of Boston, has introduced a bill into the Massachusetts legislature to compel the placing of all electrical conductors underground and for the establishment of a commission to have charge of all electrical subways. This is to apply to all cities averaging a population of 300,000 or more. Present underground conduits are not to be changed.

Public opinion has changed somewhat owing to the recent severe fires in Boston. At the big Summer street fire a great deal of trouble was caused the firemen by the wires, but they were mostly telephone and telegraph wires. The West End company did all that was possible in removing its overhead wires, and if there had been no others there, there would have been little trouble. It seems to be the general opinion that the trolley system is a necessary one, and the best that can be provided. With this as an admitted necessity, the cry now is for the telephone and telegraph wires to go underground. The insurance companies are alive to the matter, and their heavy losses have caused them to cast about for a means of preventing similar catastrophes in the future.

Putting the Boston fire alarm wires underground is not advancing rapidly at present, on account of the lack of appropriations. This season there has been laid one cable, from Waltham street through the old burnt district to City Hall. This is laid in a three-inch iron pipe bedded in concrete, and is over ten thousand feet in length and

contains over 600,000 feet of wires. The department is anxiously awaiting the appropriations from the city council to see how much work it will be able to do in this line the coming season.

The Edison Illuminating company of Boston is making arrangements to supply the demand for electric lights in the rapidly growing sections of South Boston. To do this by means of cables laid through the streets would necessitate a roundabout and expensive route, but ti is going to obviate this by making a short cut across the harbor and laying a submarine cable. This will run from the new mammoth station on Liverpool wharf. It is proposed to lay three cables of 1,000,000 circular mils each. They will be 1,180 feet long and weigh four tons each. To lay them, a trench 8 feet deep will be dug by divers across the bed of the harbor.

The fender problem for electric cars is still mooted in Boston. Not satisfied with its former attempts to settle this matter the city council has taken this matter in hand again. This time it has requested the mayor to notify all railroad companies running electric cars in the city to equip their cars within 30 days with fenders similar to those now used on steam locomotives. The outcome of this will be interesting.

The preliminary survey for an electric road between Salem and Haverhill has been completed as far as Topsfield. The road is designed to compete with the Boston & Maine railroad for local traffic. It will be twenty-two miles long and power will be furnished from two stations. It is said that the promoters of the road will also ask for permission to furnish the towns along the route with electricity for lighting purposes and to carry on an express business. In connection with this system another road is expected to be built to connect Georgetown with Newburyport.

The Giant Electric Motor company of Portland, Me., is making arrangements to move its works across the harbor to Cape Elizabeth. They will build four two-story buildings, 150x75 feet. An electric crane costing $10,000 will be one of the features of the new plant.

Mayor Matthews of Boston has been requested by the city council to notify all railroad companies who have the right to transmit electricity by wires through the city to at once establish switch boxes within half a mile of the City Hall by means of which the current can be turned off from any given section in case of fire. J. C. E.

PERSONAL.

A. M. Searles has been appointed manager of the supply department of the General Electric company, Chicago.

Geo. P. Hampton, chief engineer Cooper-Hampton Electric company, Minneapolis, Minn., was in Chicago last week.

Dr. John McKinlock, Chicago, has been appointed medical director in Chicago for the Commercial Alliance Life Insurance company of New York.

Nelson W. Perry has accepted the position of associate editor of the *Electrical World*, New York, and will have charge of the editorial department of that paper.

E. L. Smith, formerly general manager of the Crown Electric Manufacturing company of Bridgeport, Conn., has accepted a position with the Nathan Manufacturing company of New York.

Edward Caldwell has resigned his position as associate editor of the *Electrical World*, to assume the duties of editor of the *Street Railway Gazette*, Chicago. Mr. Caldwell announces that together with friends he has secured a controlling interest in that journal. He has had considerable experience in electrical newspaper work, and before entering that field was connected with the Sprague Electric Railway & Motor company and the West End Street Railway company of Boston. While Mr. Caldwell's experience has been gained in the East, he has many friends in the West who will welcome his coming to Chicago, and wish him success in his new enterprise.

NEW INCORPORATIONS.

Flatbush District Telegraph company, Flatbush, N. Y.; capital stock, $10,000; Electric Telegraph and Telephone company.

Willson company, Bozeman, Mont.; capital stock, $75,000; general mercantile business and operating electric light plants.

Metropolitan Development company, Norfolk, Va.; capital stock, $1,750,000; internal improvement, water, gas and electrical works and contractors.

Waverly, Sayre & Athens Electric Traction company, Sayre, Pa.; capital stock, $25,000; constructing and operating electric railway in Bradford county, Pa.

Electric Appliance company, Portland, Maine; capital stock, $30,000; to manufacture and sell electric and other machinery; Clarence Hale, Portland, Maine.

Illinois Electrical Forging company, Chicago, Ill.; capital stock, $2,000,000; to manufacture and deal in electrical and other machinery, tools, etc., and furnish light, heat and power to other parties; Cratty Bros. & Jarvis, 814 Tacoma bldg., Chicago, Ill.

Hammond Light & Power company, Chicago, Ill.; capital stock, $50,000; to furnish light, heat and power; Stephens & Young, 164 Dearborn street, Chicago, Ill.

Chestatee company, East St. Louis, Ill.; capital stock, $100,000; mining, supplying electric and water power in state of Georgia; Thos. L. Fekete, East St. Louis, Ill.

Electric corporation, Portland, Me.; capital stock, $1,000,000; to manufacture and deal in electrical instruments and equipments of all kinds; Coombs & Beal, Portland, Me.

Illinois Municipal Improvement company, Bloomington, Ill.; capital stock, $50,000; to equip, maintain and operate electric light and water works; E. B. Hillman & Co., Peoria, Ill.

Union Street Railway company Freeland, Pa.; capital stock, $18,000; constructing and operating an electric railway in Luzerne county, Pa.; D. J. McCarthy, Freeland, Pa.

Scranton Rapid Transit company, Scranton, Pa.; capital stock, $60,000; constructing and operating an electric railway in Lackawanna county, Pa.; James H. Terry, Scranton, Pa.

Lakeside Railway company, Shenandoah, Pa.; capital stock, $50,000; constructing and operating an electric railway in Schuylkill county, Pa.; Jno. F. Finney, Shenandoah, Pa.

Conestoga Valley Railway company, Lancaster, Pa.; capital stock, $600,000; constructing and operating an electric railway from Lancaster to Reading; John A. Coyle, Lancaster, Pa.

Lackawanna Street Railway company, Lackawanna, Pa.; capital stock, $60,000; constructing and operating an electric railway in Lackawanna county; Hon. M. E. McDonald, Scranton, Pa.

Electric Railway Switch company, Portland, Me; capital stock, $400,000; to manufacture and deal in all kinds of electrical and mechanical apparatus; Drummond & Drummond, Portland, Me.

Finney Motor company, Chicago, Ill.; capital stock, $10,000; to manufacture and sell motors and do general machinery business; Dyrenforth & Dyrenforth, 225 Dearborn street, Chicago, Ill.

San Francisco Electric company, San Francisco, Cal.; capital stock, $100,000; to generate electric light and power, deal in machinery and supplies for same; H. E. Monroe, San Francisco, Cal.

Oliphant & Winton Traction Street Railway company, Winton, Pa.; capital stock, $30,000; constructing and operating an electric railway in Lackawanna county, Pa.; Geo. S. Horn, Scranton, Pa.

Chicago-Topeka Light, Heat & Power company, Chicago, Ill.; capital stock, $1,200,000; manufacture and supply light, heat and power; Aldrich, Payne & Defrees, 1,108 Home Ins. Bldg., Chicago, Ill.

Electro-Chemical & Specialty company (incorporated in W. Va.), New York, N. Y.; capital stock, $100,000; manufacturing and dealing in electrical chemicals, etc.; A. G. N. Vermilya, Temple Court, New York, N. Y.

Wissinomiog, Bustleton & Somerton Railway company, Bustleton, Pa.; capital stock, $18,000, constructing and operating an electric railway in Philadelphia county, Pa.; A. K. Pedrick, 233 South Fourth street, Philadelphia, Pa.

Termical Land & Milling company, Everett, Wash.; capital stock, $100,000; to deal in mines and mining properties, build, equip and operate railroads, electric light plants, etc., water works, gas works, etc.; Edward Mills, Everett, Wash.

Jenkintown Electric Railway company, Jenkintown, Pa.; capital stock, $150,000; constructing and operating an electric railway in Jenkintown, Montgomery county, Pa., Hannis, Parrish & Williams, 526 Drexel building, Philadelphia, Pa.

Schuylkill Valley Illuminating company, Philadelphia, Pa.; capital stock, $30,000; supplying light, heat and power by electricity to the public at Phœnixville, Chester county, Pa.; Wm. C. Hannis, 526 Drexel building, Philadelphia, Pa.

Lancaster & Philadelphia Electric Railway company, Lancaster, Pa.; capital stock, $1,500,000; constructing and operating an electric railway from Lancaster, Lancaster county, to Bryn Mawr, Montgomery county; John J. Patterson, Mifflintown, Pa.

Greenwood Lake Telephone & Telegraph company, (incorporated in W. Va.) New York, N. Y.; capital stock, $50,000; constructing and maintaining lines of magnetic or electric telegraph and telephones; Fred W. Hinrichs, 115 Broadway, New York, N. Y.

Everett Railway & Electric company, Everett, Wash. capital stock, $200,000; to build, equip and operate street and other railways, electric light and power plants, gas works and to deal in bonds and other securities; Brown & Brownell, Everett, Wash.

ELECTRIC LIGHTING.

The town Cloquet, Minn., is to be lighted by electricity.

Marshfield, Wis., is to put in a $25,000 electric light plant.

The Bridgeport, Conn., Electric Light company has increased the capital stock of the company from $200,000 to $300,000.

Electric lighting for the town Newberry, Mich., is being agitated.

The board of supervisors of Denver, Colo., contemplates a removal of the tower lights.

The water works and electric light plant at Tipton, Iowa, has been destroyed by fire; loss, $7,000.

A special election is to be held at De Graff, O., to vote on a proposition to establish an electric light plant.

The new Omaha Thomson-Houston Electric Lighting company has increased its capital stock to $1,100,000.

The city of Wausau, Wis., will ask the Legislature to authorize a loan of $25,000 to put in an electric light plant.

L. N. Cox of Washington, D. C., is trying to get the city of Charleston, S. C., to put in a $50,000 electric plant.

Green Island, N. Y., officials celebrated by a banquet the completion of the new electric light plant in that village.

Madison, Wis., is to have its electric light wires changed from the streets to the alleys, and to enter buildings from the rear instead of front.

At the annual meeting of the Narragansett Electric Lighting company of Providence, R. I., the capital stock was increased to $1,200,000.

The council of Trenton, N. J., is dissatisfied with the price it is paying for light and is contemplating the establishment of a municipal plant.

An electric light plant is to be established at Fergus Falls, Minn., in the spring, the power for which will be obtained by constructing a dam across Red River. The improvement will cost $50,000.

The *American* of Sunbury, Pa., is sarcastic. "If you want a good view of the Edison electric light," it says, "select a bright day about noon. It can be seen in the evening by holding a lamp close to it."

The Tiffin, O., Electric Light company's works, including the uncompleted plant being erected to furnish power for the two electric street railway companies, which would soon have started their cars, was destroyed by fire on January 17th, entailing a loss of $30,000 partially covered by insurance.

The city of Davenport, Iowa, has an exceedingly favorable contract with an electric light company, which provides that if for any reason whatever, whether it be for a minute or all night, a light shall go out during the time it should be burning, the company shall forfeit to the city 40 cents for each arc light and 20 cents for each incandescent light so extinguished. The operation of this contract at the end of a month has made the company owe the city some $800. The city council insisted on the pound of flesh, and the matter was taken into the courts, where the decision asserts the validity of the contract.

ELECTRIC RAILWAYS.

An electric railway is to be constructed at Bristol, Pa.

An electric railway is projected at Phœnixville, Pa., and will be constructed.

An electric railway is projected between Camden and Woodbury, N. J.

The railway system at Fond du Lac, Wis., is to be changed to electric power.

An electric line will be run from Ashland to Parishville, Wis., a distance of seven miles.

Akron, Cuyahoga Falls and Silver Lake, O., are to be connected by an electric railway.

Terre Haute, Ind., capitalists have projected an electric railway line between that place and Harmony.

The Elgin, Aurora and Fox River Electric Railway company will build an electric line to Montgomery, Ill.

A local company is seeking to obtain a franchise to construct and operate an electric railway at Wausau, Wis.

The Susquehanna Valley Electric Traction company has been incorporated to build and operate an electric road at Waverly, N. Y.

The Schuylkill Valley Electric Railway company is seeking a franchise to build and operate an electric railway at Royer's Ford, Pa.

It is proposed to build an electric railway to connect Cumberland and Westernport, Md., a distance of 30 miles. The first section to be built will be between Lonaconing and Frostburg.

The county commissioners of Huron county, O., have granted the Sandusky, Milan and Huron Electric Railway company the right to construct an electric railway from East Milan to East Norwalk.

The Montgomery, Ala., Terminal Street & Railway company has decided to equip its entire system of street and suburban roads with electricity, and bids for first class equipment are to be asked for at once.

Chicago capitalists are negotiating for the narrow gauge railway between Wilmington and New Castle, Del., and if the deal is made they will change the road to an electric railway and put in an electric light plant.

A trial trip on the Liverpool, Eng., Elevated Electric

railway took place recently. Although the weather was unfavorable the results were very satisfactory, the speed of the train averaging between 20 and 30 miles an hour. The formal opening of the line will take place in a few days.

A franchise has been granted by the county commissioners at Marion, Ind., for an electric railroad to Gas City—a distance of six miles. A bond of $7,000 requires, operation by July 15th. This is the beginning of a system which is expected to connect all the principal points in the Indiana gas fields.

The Wichita, Kan., electric railway has been sold by the sheriff, under a mortgage of $300,000. The property was bought in by the bond holders, capitalists of Boston, and Keene and Nashua, New Hampshire. There will be a reorganization of the company, but the management will remain in the same hands.

TELEGRAPH.

The select and common council of Philadelphia have passed an ordinance appropriating $198,740 for the electrical bureau. This means the improvement and extension of the police and fire telegraph system and the improvement of the police signal and telephone service.

The Texas Central Railway company, operating from Waco to Albany, will construct a new telegraph wire along its line, which is made necessary on account of the increasing business of the road. The new wire will probably be of copper. The construction of the line will be under the joint supervision of the Western Union Telegraph company and the Texas Central railway.

In the federal court at Wichita, Kan., Thomes McGill, a Lane county farmer, secured a verdict for $5,000 against the Western Union Telegraph company for failure to promptly deliver a message. McGill's wife was in such a condition that an operation was deemed necessary and the physician in attendance telegraphed to a neighboring town for another to administer chloroform. The message was not delivered until too late and the woman died.

MISCELLANEOUS.

The electric linemen who cut the lines at Toledo during a recent strike have been indicted by the grand jury.

Steps are being taken to establish telephonic communication between Denmark and Sweden under the sound.

The C. & G. Electric company of Atlanta, Ga., has passed into the hands of a receiver. The liabilities are $3,500, with assets of $2,000.

The proposed plans for the laying of the Missouri Electric Light & Power company's wires under ground at St. Louis make a book about three feet square and six inches thick.

The students at Harvard university have reorganized the Harvard Electric club. Prominent electricians will address the club, and members will read papers before it. The club is not to be a purely social organization, but its object is to promote knowledge of electricity and kindred subjects.

Since the introduction of electricity on the street railroads in this country, the industry of raising large horses in Canada is said to be disappearing because there is no demand for this kind of horses. The change has reduced the price of horses in Canada one half and has depressed financially many who were engaged in raising horses.

The report of the electric wire inspector of St. Paul, Minn., shows that during 1892 inspections were made in that city as follows: Generators, 41; motors (120 horsepower) 473; arc lights, 815; incandescent lights, 14,900; incandescent wiring, 894; aerial wires, 79; electro heating, 17; storage battery, 30; separate inspections, 1,329; accepted, 1,085; condemned, 244.

Senator Mitchell's bill providing that no one shall use electricity upon another under penalty of death is a strange measure to be introduced by a grave and reverend senator, says the Oakland, Cal., *Times*. Whatever the senator desires to accomplish is not shown in the wording of the bill, which, as it stands, is decidedly absurd. Electricity is a valuable aid to therapeutics, and a senator attempting to prohibit its use in such a connection only invites criticism.

Dr. Gatling of Gatling gun fame is attracting the attention of army and navy officers through the knowledge that he has perfected a device for applying electricity to firearms. Dr. Gatling claims to have a new gun which will discount the Gatling, the mitrailleuse, and all other rapid-firing guns. The new gun will shoot 2,000 shots per minute. The motive power consists of an electric motor attached by a belt to the mechanism of the gun, and the cost of discharging is said to have been reduced to the minimum. A test is to be made shortly before a board of ordnance officers.

A local paper at Newburyport, Mass., tells a story of an arc lamp trimmer who had a practical demonstration of the value of paper insulation. It is related that the man in question entered a store to trim a lamp. He shut off the current, laid two sheets of ledger paper upon the steam radiator, so as not to mar it as he climbed up to the lamp. He trimmed the lamp, turned on the current, and while still standing upon the carbon stepped upon the paper on the radiator. He received a shock, but the current was broken enough by the paper to enable him to release his hold, and he fell back unconscious. His right hand was badly burned and he received bruises by the fall. He soon regained consciousness.

The Auburn, Me., Electric Motor company held its first meeting to perfect an organization and elect officers on January 24th. The following named officers were elected: Chas. H. Lucas, president; J. P. Hutchinson, secretary and treasurer; Chas. H. Lucas, Walter F. Brown, Henry J. Davis and J. P. Hutchinson, directors; Chas. H. Lucas, superintendent mechanical department, and Walter F. Brown, electrician and superintendent electrical department. The capital stock is $50,000, of which $2,100 is already paid in. A large building for the factory has already been secured, and it is expected that the company will occupy it within a month, when the manufacture of motors and dynamos and a general electrical business will be carried on.

TRADE NEWS.

Taylor, Goodhue & Ames, Chicago, have issued a neat little pamphlet describing the Diamond transformer recently illustrated in this paper. The little work has considerable data on transformers which will be of interest to central station managers.

The Davis Electrical Works, Springfield, Mass., has issued a calendar intended for users of incandescent lamps. It warns consumers not to break burned out lamps, but to send them to their factory and have the old filament replaced by a new one.

H. W. Weller, of the New York office of the railway department of the General Electrical company, has been in charge of the railway supply house in New York since December 1st, and since he has had this department under his care, the results have been more than satisfactory.

Riehle Bros. Testing Machine company, Philadelphia, has recently secured a number of large orders for its machines and devices, including the Riehle-Robie screw jack, hydraulic press screw power testing machines, straw rope twister and marble machines. Electric manufacturing companies are using these machines extensively.

The Riker Electric Motor company of New York has issued an elaborate catalogue in which considerable information may be found concerning directly connected engines and dynamos, search lights, storage batteries, electric launches, fixtures and dynamo machinery generally. The catalogue is profusely illustrated and is certainly a creditable production.

The Ball & Wood company of New York has issued a handsome catalogue containing considerable information on engines, which will prove valuable to central station managers. The catalogue is handsomely printed, profusely illustrated, and is really worthy of more than passing notice. It contains much information about the development of high speed engines.

William H. McKinlock, president of the Central Electric company, Chicago, has just returned from a short trip in the East, where he has perfected arrangements for the introduction and sale of several new specialties. The Central Electric company, in preparation for the spring trade, is looking about for new quarters in which to house its large stock of supplies which increasing business compels it to carry in order to meet the requirements of the trade and fill orders with promptness. The company has recently added largely to its force, and predicts a large trade for the spring.

BUSINESS.

The Automatic Switch company, of Baltimore, Md., has moved from its old offices in the Keyser building to larger quarters in the Equitable building.

The New Jersey Lamp & Bronze Company, of New Brunswick, N. J., has issued a handsome catalogue, profusely illustrated, showing the latest designs in electrical fixtures.

The Electric Appliance company is receiving the first large shipment of its new lamp sockets to be known as the Acme. While the socket has no peculiarly startling features, it has a number of small improvements in details, such as an increased amount of room for the wiring cord; extra long contact screws for securing the cord; a heavy and handsome shell;—in fact it is a well made socket in every way. The Electric Appliance company is putting in a large stock in anticipation of a heavy demand.

Secretary Preble of the Chicago Rawhide Manufacturing company, Chicago, relates an interesting experience with one of the first VanDepoele machines. This dynamo was designed to supply six arc lamps of 2,000 candle power, but owing to a poor belt it was apparently a failure, as it would furnish hardly enough current for three lamps. Rawhide belting, however, was tried as a last resort and now the company refers with pardonable pride to the fact that from that time on they had no firmer friend than Mr. VanDpoele.

It is announced by the local representatives of the Chicago & St. Louis Electric Railroad company that twenty-six miles of the roadway has been prepared for ties and rails, and that the work is being rapidly pushed at several points by large gangs of workmen. Dr. Adams' method of suspending motors is briefly considered in Anthony Reckenzauo's work on "Electric Traction on Railways and Tramways," in which the following paragraph appears: "He suspends one bearing, which supports the motor frame, upon the car axle, and the other end of the motor, or, more properly speaking, its weight, by means of springs from either the framework or the body of the car. This system has advantages. It assists the starting of the car. As the car starts there is an initial torque upon the armature, which, before the car wheel begins to rotate, tends to compress the spring, which, in resuming its former shape, helps to start the car. Secondly, the jarring owing to the roughness of the track is not transmitted directly to the armature, but through an elastic medium; and it gives a flexible base."

ELECTRICAL PATENTS.

Issued January 24, 1893.

490,279. Electric Meter. Oscar Froelich, Berlin, Germany.

A bar of soft iron movable in a horizontal plane is surrounded by two coils, one of which has a magnetizing and the other a deflecting action on the bar; both coils are traversed by the current to be measured, or by fractions thereof, while by means of suitable apparatus a change of current is effected in one of the two coils, thus causing the iron bar to partake of an oscillating motion. The number of oscillations of the iron bar will be proportional to the current to be measured, so that if the number of oscillations produced be registered on a counter, the latter will indicate directly the number of ampere hours in the working circuit.

490,280. Electric Motor. Julius W. Hansen, St. Paul, Minn.

490,292. Cut Out for Electric Circuits. Michael Leavy, Pittsfield, Mass.

490,297. Electric Railway Conductor. Howard A. Miner, New York, N. Y.

A feeder wire is suspended immediately above and in close proximity with the conductor wire, and serves by the aid of a partial inclosing case as a support and guide, and also as a feeder for the conducting wire. The casing is partly or entirely of non-conducting material, and completely covers both wires except a narrow space directly under the conducting wire. The trolley wheel is provided with a central web that extends into the opening in the enclosing case and makes contact with the conducting wire.

490,302. Insulator. Louis McCarthy, Boston, Mass.

490,306. Closed Conduit for Electric Railways. Russell Parker and Benjamin F. Sutton, Brooklyn, N. Y.

The conduit is designed for systems in which the trolley wheel exerts an upward pressure upon the conducting wire. It consists of a flexible insulating tube suspended by clamps; a main conductor extending along the interior of the tube and being supported between the jaws of the clamps, while in the lower side of the tube is secured the trolley conductor, which is made in sections. One face of the trolley conductor extends through the tube and is adapted to come in contact with the trolley wheel. As the trolley wheel passes over the sectional conductor it presses the same against the feeding conductor in the top of the tube, thus establishing a connection between the car and the feeding conductor.

490,307. Electric Locomotive. Alexander Philipsborn and Max Schiemann, Berlin, Germany.

490,327. Electric Annunciator System. Henry Van Hoevenbergh, New York, N. Y.

490,353. Electric Mat. William G. James, Harlem, Ill.

The invention is designed for an electrical alarm whereby when pressure is brought to bear upon the mat by the foot or otherwise the circuit is closed between the two metallic normally insulated sides of the mat.

490,358. Electrical Musical Instrument. Anacleto Montanelli, Portland, Ore.

The object of the invention is to produce the same tones upon a plurality of instruments simultaneously while but one is operated manually. The instrument that is operated manually is provided with circuit closing devices connected in circuit with electro-magnets that may act when energized to draw down the keys of a key board instrument to cause the hammers to strike the strings of a piano, or to open the air passages to the reeds of the organ. If the manually operated instrument be a mandolin or guitar, the depressing of the strings against the neck of the instrument serves to close the circuit through the proper electro-magnets at the piano or organ, thus reproducing the same tones that are produced in the mandolin or guitar.

490,363. Electric Switch. Albert L. Rohrer, Lynn, Mass.

490,376. Armature for Dynamo Electric Machines or Motors. Elihu Thomson, Swampscott, Mass.

A sectional laminated core for armatures is provided with overlapping sections provided with holes near the inner edges through which slotted binding rods pass.

490,381. Dynamometer. John B. Webb, Millburn, N. J.

490,449. Dynamo Electric Machine. Robert Lundell, Brooklyn, N. Y.

The motor or dynamo has a single field magnet coil which incloses or surrounds inwardly projecting field magnet poles; the armature has its axis coincident or parallel with the axis of the field magnet coil, the poles being located in the annular space between the field magnet coil and the armature.

490,460. Dynamo Electric Machine. Charles Wachtel, Newark, N. J.

490,477. Electrical Connecting Device. Joseph Hutchinson, New York, N. Y.

490,479. Electric Show Case Alarm. Rudolph C. Kruschke, Duluth, Minn.

490,497. Process of Purifying Pyrolignites. Frederick H. Pickles, Fairfield, and Robert H. Pickles, Marple, Eng.

An insulated conductor is connected with the dynamo and a sectional contact conductor is provided, the sections being normally disconnected from the insulated conductor and from each other; one or more electro-magnets are provided which, at the time a current collector passes off of a section preceding a given section and on to the given section, disconnect the preceding section from and connect a succeeding section with the insulated conductor.

490,549. Elevated Railway System. Charles Drill and Henry J. Schmitt, St. Louis, Mo.

490,560. Insulator. Auguste J. Hauty, Saltsburg, Pa.

490,597. Conductor System for Electric Railways. Raphel Hayden, Fairmont, W. Va.

490,605. Electric Lamp Socket and Tap. Alexander F. Vetter, New York, N. Y.

490,607. Apparatus for Distributing Mail. Frederick D'A. Goold, New York, N. Y.

490,626. Railway Signal. Ira L. Green, Kittanning, Pa.

490,630. Electric Conduit. Ernest L. Ransome, Oakland, Cal.

A water conduit is provided with passages for electric conductors formed in the walls of the water conduit, double manholes being provided, one opening into the water main and the other into the passages for the electric conductors.

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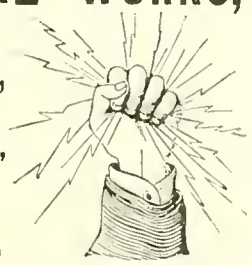

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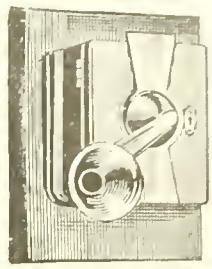

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WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

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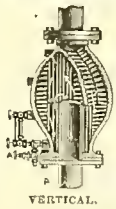

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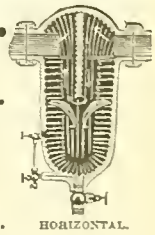
Steam Separators and Oil Extractors.



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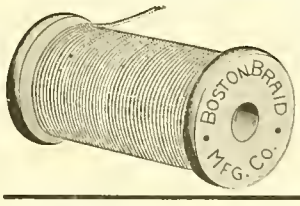

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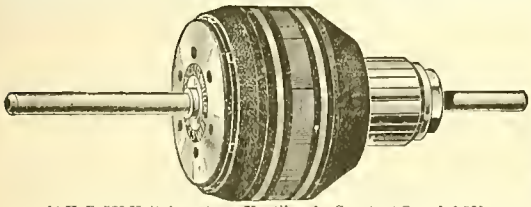

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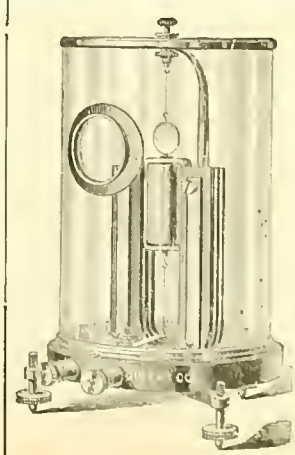

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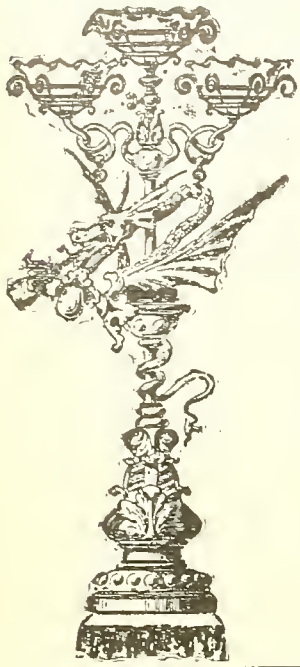

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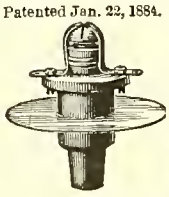

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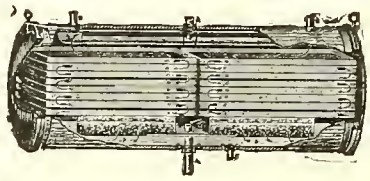

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The Scientific American's Opinion.
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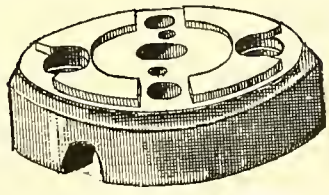

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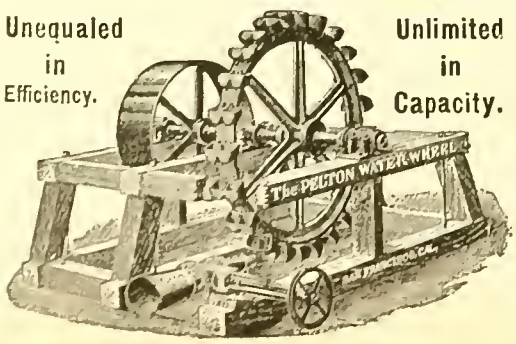

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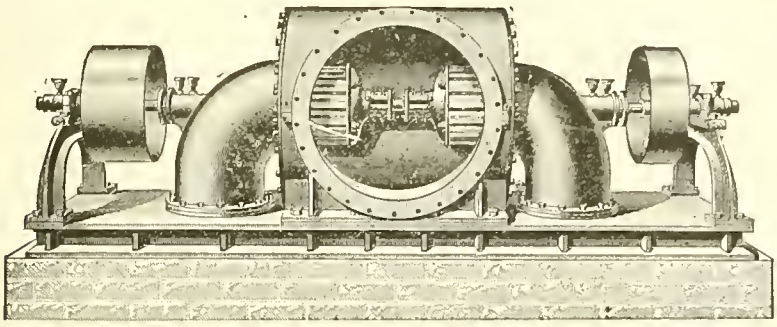

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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The accompanying engraving represents a pair of 12 inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

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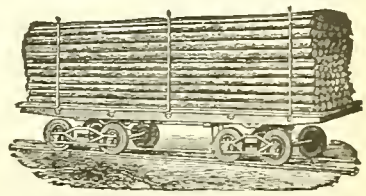

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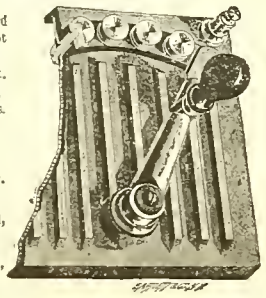

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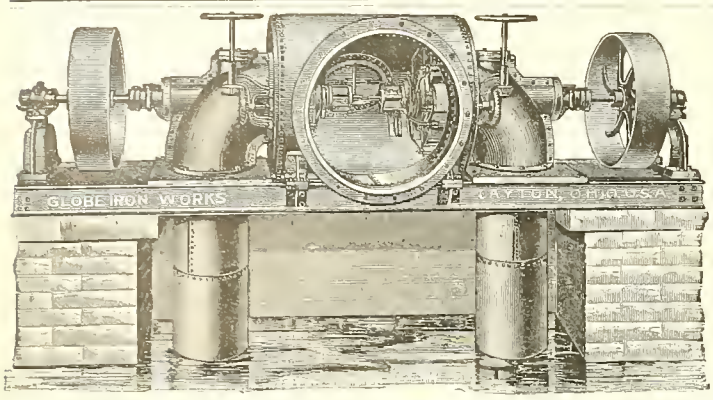

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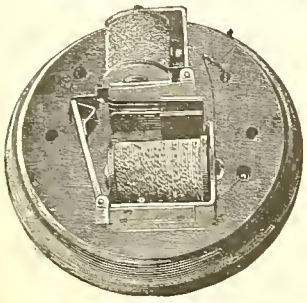

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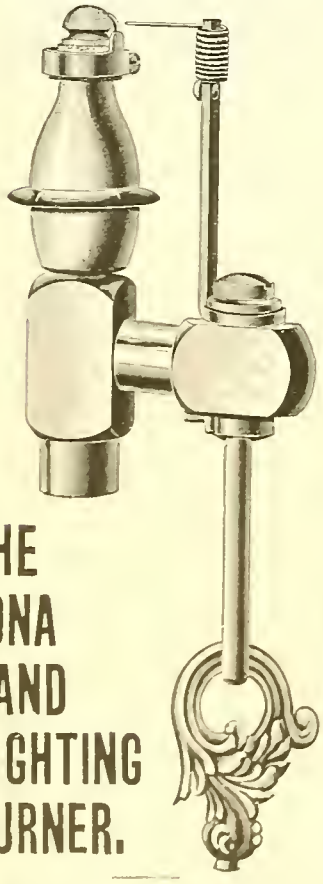

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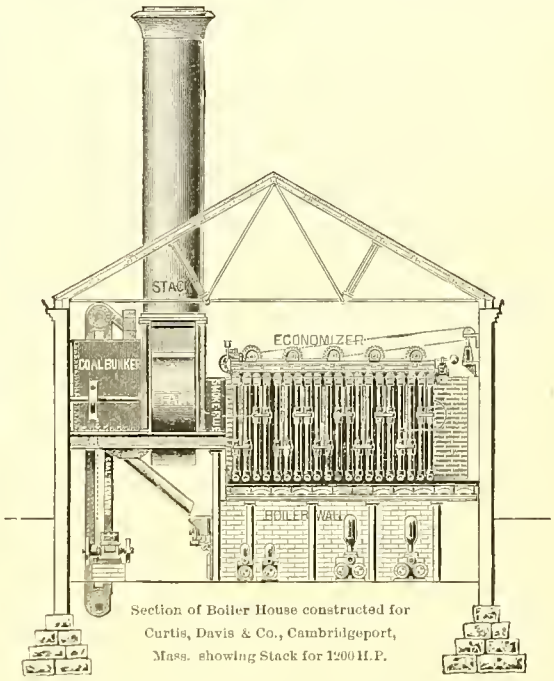

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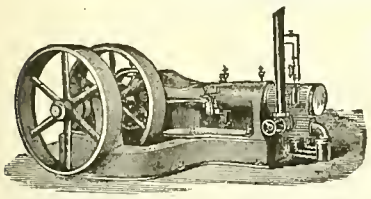

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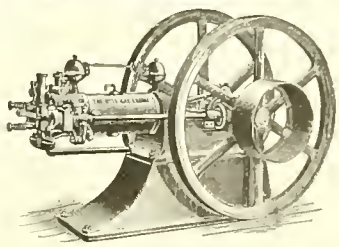

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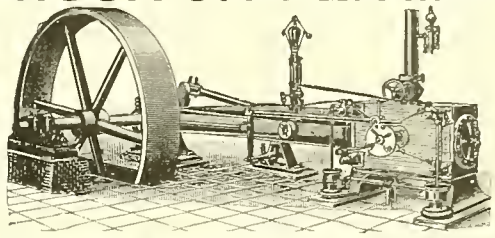

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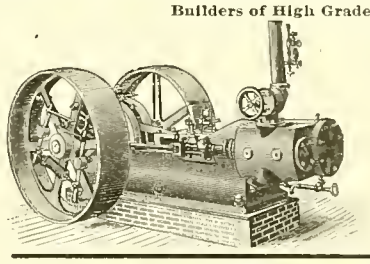

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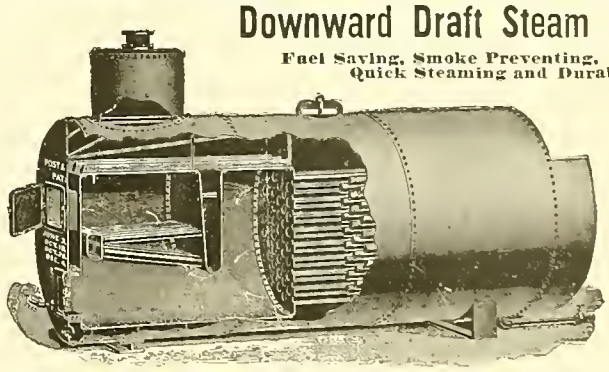

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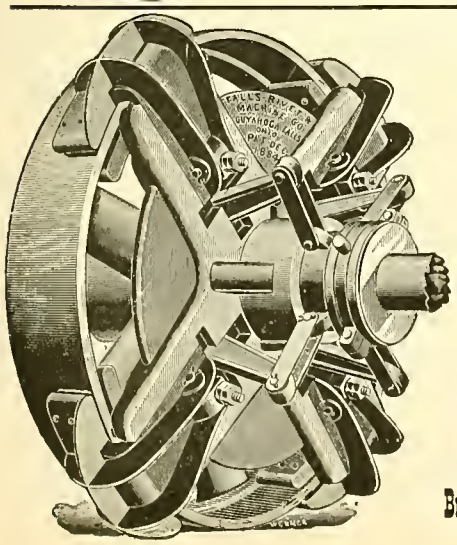

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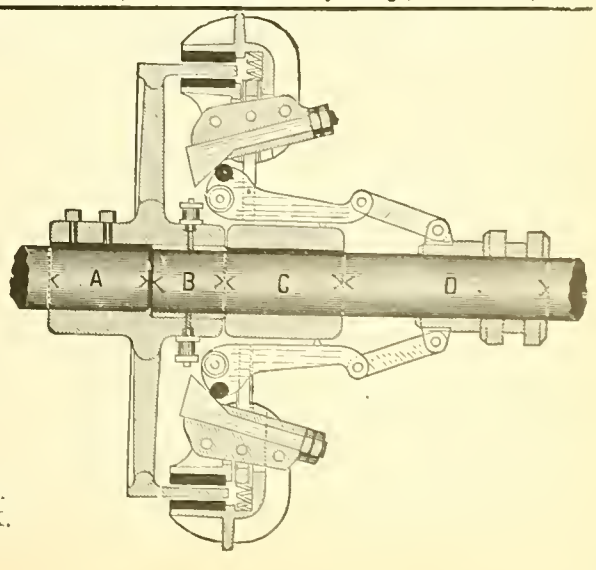

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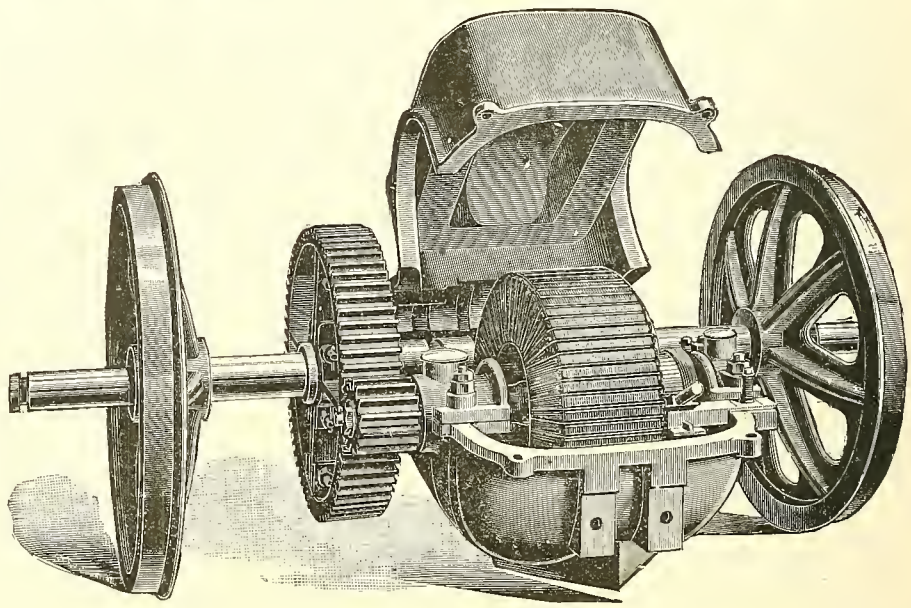

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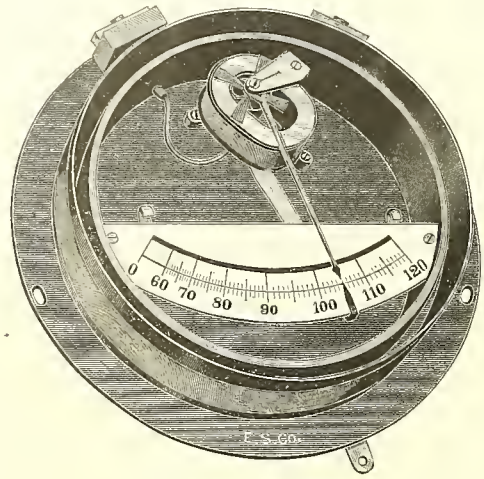

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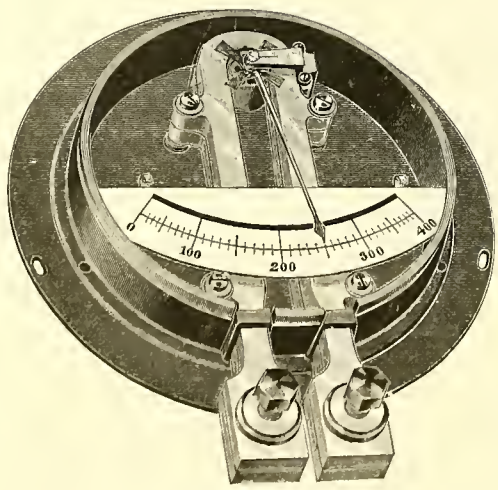

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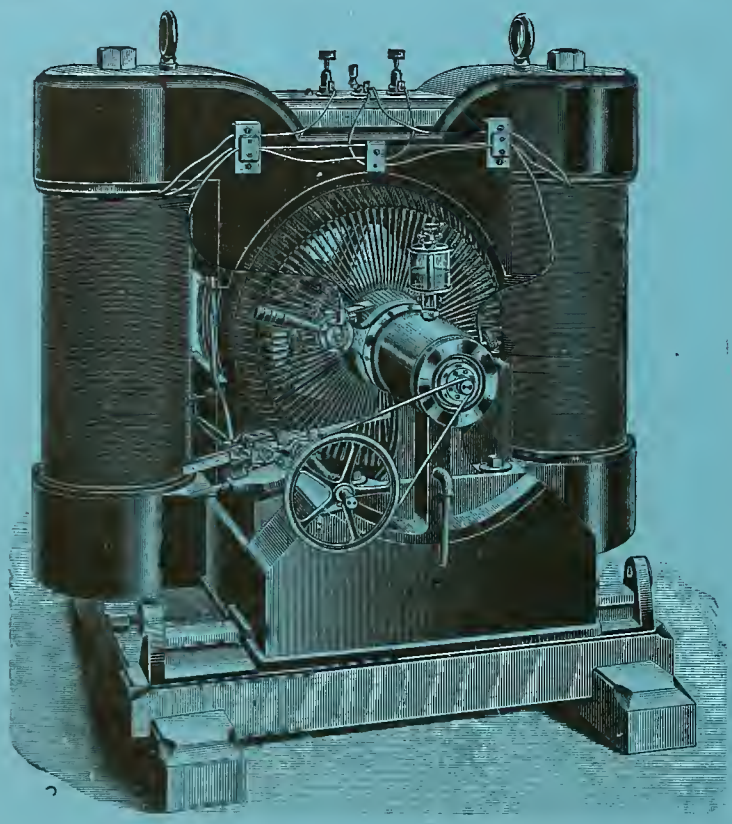

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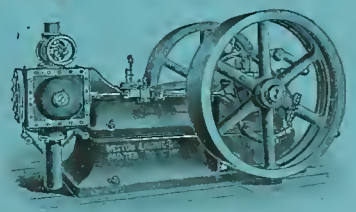

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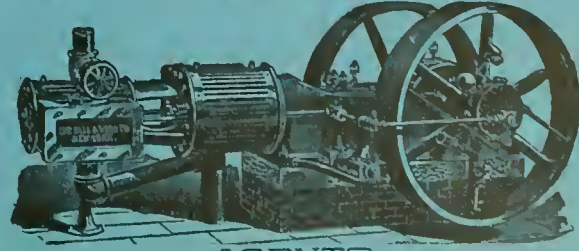

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Ostrander & Co., W. R.
Partrick & Carter Co.

Arc Lamps.
Beggs, J. E., Mchy. & Supply Co.
Duplex Electric Co., Ltd.
Electric Cons. & Supply Co.
General Electric Co.
General Incandescent Arc Lt. Co.
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Rose Electric Light Supply Co.
Siemens & Halske Electric Co.
Standard Electric Co.
Waterhouse, Gamble & Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Knapp Electrical Works.
Samson Cordage Works.

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Greeley & Co., The E. S.
Knapp Electrical Works.
Leclanche Battery Co., The.
Partrick & Carter Co.
Western Electric Co.

Battery Jars.
American Battery Co.
Butler Hard Rubber Co.
Central Electric Co.
Electric Gas Lighting Co.
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Knapp Electrical Works.
Leclanche Battery Co., The
Western Electric Co.

Bells, Electric.
Central Electric Co.
Electric Gas Lighting Co.
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Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Electric Gas Lighting Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co

Belting.
Chicago Rawhide Mfg. Co.
Jewell Belting Co.
Page Belting Co.
Shultz Belting Co.

Boilers.
Babcock & Wilcox Co., The.
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Freeman Sons Mfg. Co., The S.
Lane & Bodley Co., The.
N. Y. Safety Steam Power Co.
Weston Engine Co.

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Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electric Appliance Co.
Electric Gas Lighting Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.

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(See Insulated Wires.)

Cables, Electric. (See Insulated Wires), **Copper, Sheet and Bar**
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Eastern Electric Cable Co.
Moore, Alfred F.
Roebling's Sons Co., J. A.
Washburn & Moen Mfg. Co.
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Knapp Electrical Works.

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Falls Rivet & Machine Co.
Hill Clutch Works.
Lake, J. H. & D. Co.

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Samson Cordage Works.

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Comstock, Louis K.
Electric Cons. & Supply Co.
Western Electric Co.
Wilson & Jackson.

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American Engine Co.
Babcock & Wilcox Co., The.
Ball Engine Co.
Ball & Wood Co., The.
Brush Electric Co.
Cabell, L. Breckinridge.
Comstock, Louis K.
Diamond Electric Mfg. Co.
Ford-Washburn Storelectro Co.
Freeman Sons Mfg. Co., The S
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Westinghouse, Church, Kerr & Co.
Western Electric Co
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Cutter, Geo.
Electrical Supply Co., The.
Enterprise Electric Co.
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International Okonite Co., The.
Knapp Electrical Works
Moore, Alfred F.
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Sperry Elec. Mining Machine Co.
Washburn & Moen Mfg. Co.
Western Electric Co.

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Knapp Electrical Works.
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Cutter, Geo.
Cutter Electrical & Mfg. Co.
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Electrical Supply Co., The.
Enterprise Electric Co.
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Hart & Hegeman Mfg. Co., The.
Hood & Co., Wm.
Knapp Electrical Works.
Partrick & Carter Co.
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Redding Electric Co.
Russell & Officer.
Sawyer-Man Electric Co.
Sechrist, A.
Utica Elec. Mfg. & Supply Co.

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Manz & Co.

Dynamos.
Brush Electric Co.
Diamond Electric Mfg. Co.
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Electrical Eng. & Supply Co., The.
General Electric Co.
Great Western Mfg. Co.
Heisler Electric Co.
La Roche Electric Works.
National Electric Manufacturing Co.
Nowotny Electric Co.
Rose Electric Light Supply Co.
Siemens & Halske Electric Co.
Standard Electric Co.
Waddell-Entz Company.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Heating.
Electrical Supply Co.
Railway Equipment Co.

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General Electric Co.
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Westinghouse Electric & Mfg. Co.

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Hatheway, E. M.
Osborne Steam Engineering Co.
Wilson & Jackson.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Knapp Electrical Works.
Queen & Company.
Western Electric Co.

Electrical Intelligence.
Comstock, Louis K.
Hatheway, E. M.
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Cutter Electrical & Mfg. Co.
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Edwards, W. S. Mfg. Co.
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Knapp Electrical Works.

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Ball Engine Co.
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National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

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Samson Cordage Works.

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General Electric Co.
Westinghouse Electric & Mfg. Co.

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Dayton Globe Iron Works Co.
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Institute of Technology.

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Mass. Chemical Co.
Standard Paint Co.

Water Wheels.
Pelton Water Wheel Co.

Wire, Bare.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Electrical Supply Co.
Holmes, Booth & Haydens.
Knapp Electrical Works.
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Railway Equipment Co.
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—ESTABLISHED 1831.—

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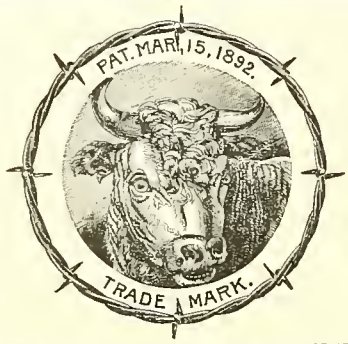
LEAD ENCASED WIRES.

HARD DRAWN COPPER TROLLEY WIRE.



Rubber, Weather-Proof and Underwriter's Wire.

ABSOLUTELY

FIRE and WATER-PROOF WIRE,

Superior to Anything Heretofore Made.

WORKS { WORCESTER, MASS. WAUKEGAN, ILL.

BRANCH OFFICES AND WAREHOUSES: { NEW YORK, 16 Cliff St. CHICAGO, 107 and 109 Lake St. SAN FRANCISCO, 8 and 10 Pine St. HOUSTON, TEXAS.

SOMETHING TO BE NOTED!

THE MORRISON STORAGE BATTERY

Is made by the Planté process, no oxides being used, either mechanically or applied in the form of paste, paint or cement.

ELECTROMOTIVE FORCE HIGH; LIFE LONG.

Dry Batteries. Battery Supplies, etc. For further information address

AMERICAN BATTERY COMPANY,

Office: Rooms 23 and 24, 177 La Salle St., CHICAGO, ILL.

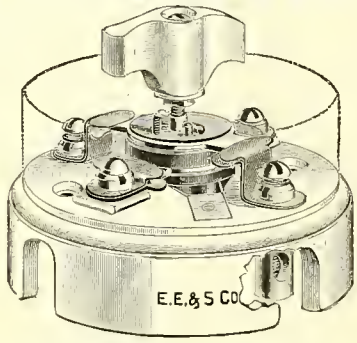
Our New WORLD'S FAIR Switch.

E asily connected.

E legant in Construction.

S afe Carrying Capacity.

C ontacts Bright.



Simpla.

Yet to be Excelled.

Rubbing Contacts.

A trial is Asked.

Compact in Form.

Used Everywhere.

Sure Quick Break.

Endorsed by Users.

25 AMPERE DOUBLE POLE SNAP SWITCH.

This switch has more carrying capacity than most switches designed for 25 amperes, and the wiping contacts constantly keeping the surface clean, the parts always run cool. The sudden break is of such length as to make the switch safe for use with currents of an E. M. F. of from 400 to 600 volts.

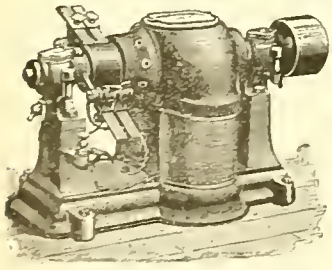
This switch is finished in the same neat and workmanlike manner as are all our goods. Send for sample. Furnished with either rubber or porcelain key. Send for our Catalogue.

Electric Engineering & Supply Co.,

New York Office, 126 Liberty St. SYRACUSE, N. Y., U. S. A.

THE BEST IS OUR KIND ALWAYS.

We want quick sales and are satisfied with small profits.



PERFECT VENTILATION, REGULATION AND GUARANTEE.

Write for Catalogue.

FORD-WASHBURN STORELECTRO CO.,

MANUFACTURERS OF DYNAMOS, MOTORS AND STORAGE BATTERIES,

Please mention this paper. Cleveland, Ohio.

RAILWAY EQUIPMENT CO.,

Pullman Building, Michigan Avenue, CHICAGO.

Electric Railway Supplies

—EXCLUSIVELY.—

Prompt Shipments.

CATALOGUES AND ESTIMATES FURNISHED.

RAILWAY EQUIPMENT CO.,

W. R. MASON, Gen'l Mgr. CHICAGO.

ANNUNCIATORS,

BELLS, BATTERIES.

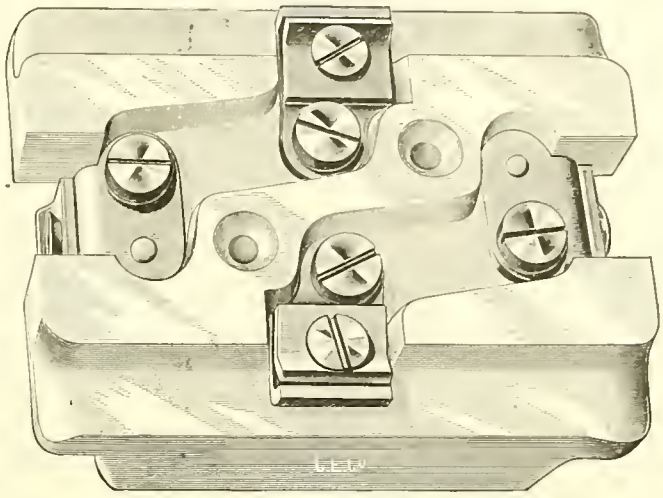
SPECIAL PRICES ON LARGE QUANTITIES.

WESTERN ELECTRIC CO.,

Corner Thames and Greenwich Sts., NEW YORK.

227 to 275 South Clinton Street, CHICAGO.

JANUARY CLEARING SALE.



We are selling at manufacturers' cost, 10 and 25 ampere Main and Branch Porcelain Blocks, Porcelain Fuse Rosettes and Key and Keyless Sockets. We have a large stock of Bryant, Perkins, Hart and Paiste Switches that we will sell at never-before heard-of prices.

We propose to give our customers the benefit of our purchases in large quantities, and prompt shipments.

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin Street, CHICAGO.

WESTINGHOUSE ELECTRIC & MFG. CO.,

PITTSBURGH, PA.,

MANUFACTURERS OF APPARATUS FOR

Arc Lighting, Incandescent Lighting,

LONG DISTANCE TRANSMISSION OF POWER,

Street Railway Generators, Motors and Appliances.

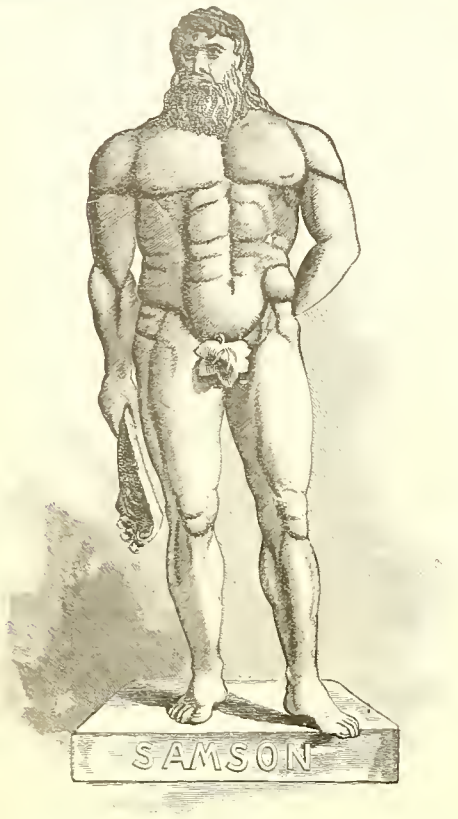
Our alternating current incandescent apparatus is in use in 430 central stations. 1,000 isolated plants. Our arc apparatus is in use all over the world.

We are now transmitting light and power various distances up to 28 miles from the source.

Our multipolar railway generators and noiseless single reduction motors have worked a revolution in the electric railway field in two years.

Orders for APPARATUS, REPAIRS and SUPPLIES formerly furnished by the United States Electric Lighting Co., Newark, N. J., should now be sent to this Company, where they will receive prompt attention.

BRANCH OFFICES IN ALL THE LEADING CITIES.
AGENTS FOR CANADA: AHERN & SOPER, OTTAWA, ONT.



THE

SAMSON BATTERY

KNOCKS 'EM ALL OUT!

Battery users generally admit the superiority of the **SAMSON** over other open circuit cells, yet occasionally one persists in handling cheaper cells which can be bought for a few cents apiece less! Isn't it strange? Some say they don't use the **SAMSON** because it affords them little "chance at repair work!" They say "it is too good;" that when "it runs down, a day's rest sets it all right again;" hence, they "get very few calls for repair work;" so they conclude that "the **SAMSON** hurts the business!" ***You see the point, of course!***

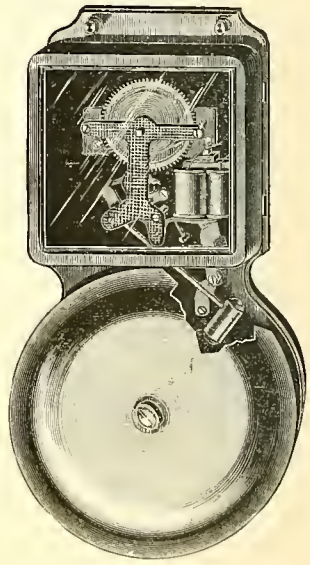
Now it is safe to assert that Contractors and Fitters who do first-class electrical work, and guarantee it, pretty generally use the **SAMSON** Battery; indeed, any Contractor who desires to hold his reputation for good, honest work will use the **SAMSON**.

When consumers want Electric Bells, Annunciators, Burglar Alarm or Gas Lighting apparatus for their houses, it is safest to apply to Contractors or Fitters who use the **SAMSON**; they are not likely to count much upon repair work for a living, nor will they knowingly put batterie into houses that will have to be changed every month or two at the owner's risk.

Always Insist upon Having the SAMSON Battery to run Electric House Plants. It Will Outwear any Other Cell.

THE "STAR"

Gong is designed for use on Railroads, in Fire Department Stations, Factories, Engine Rooms, School Houses, etc., where unerring alarms are requisite.



The mechanism is simple, and its operation accurate. The release, controlled by the electro-magnet, is provided with an attachment which holds the hammer in position **except at the instant the current ceases,** thus preventing more than one stroke for each pressure of the key. The hammer thus released falls into position for the blow, releases a stop-lever, and sets in motion **a spring mechanism geared to a five-pointed star,** one point of which forces the hammer to strike the blow. The hammer itself is faced with lignum vitæ, to render the alarm more agreeable to the ear.

One winding of the spring (*not clock work*) **will serve 300 or more blows upon the gong.**

The magnets may be wound to any desired resistance to suit the requirements of any circuit. The large sized gongs are fitted to order for use on reversal circuits. **Continuous ringing attachments** are furnished with the gongs, when so ordered, without additional cost.

The instrument, as will be seen, is equally adapted for open or closed circuit. **It is weather-proof, provided with lightning arrester,** and mounted in handsomely finished black walnut or ash case, with plate glass front.

The patent Automatic Sectional Cut-Out for the protection of Electric Gas Lighting Circuits is the only practical instrument for the purpose yet constructed. It is extensively used by the best contractors and fitters. No Gas Lighting Plant is quite complete without it.

OTHER SPECIALTIES.

The Electric Gas Lighting Co., OF BOSTON,

Begs to present some of its Specialties which it manufactures and sells in large quantities, viz:—

The "**VICTOR**" and "**SUCCESS**" **Wooden Box Bells**; the "**STANDARD**" and the "**CLIMAX**" **Iron Box Bells**; the "**BRODIE**" **LIMITED ALARM BELL**, the "**BOSS**" **BUZZER** and our **Electric Bell Outfits all take the lead as first class goods.**

The "**TIRRELL**" **Gravity Drop Annunciators and Burglar Alarms**, for Houses and Hotels, with cases in five distinct styles, are standard instruments in demand among Electrical Contractors and fitters all over the country.

The "**STAR**" **Electro-Mechanical Gongs**, for Hotels, School Houses, Fire engine Stations, Stores, Factories, etc., are thoroughly desirable instruments extensively used.

The "**O. K.**" **and Wool Pushes, Metal Pushes** in new styles, light and dark bronze, N. P. and oxidized silver, finely finished; improved **Floor** and **Pear Shape Pushes**; an elegant line of **Door Pushes and Pulls, Door Bell Pull Attachments, Presselles, Wall Rosettes, Name Plate Pushes, Desk Buttons and Pushes, Strap Signal Keys, etc., etc.**

We also make **fine Pocket Galvanometers, Medical Induction Coils without battery, the "SAMSON" (non acid), Medical Battery, Experimental Induction Coils and Electro-Magnets, Binding Posts in endless variety; Electricians' Pocket Kits, Combination Screw Driver and Nut Wrench, all of the best quality and style.**

This Company gives its undivided attention to **manufacturing a superior line of Domestic Electric goods for the trade** All customers squarely and liberally treated.

FOR CATALOGUE AND PRICE LIST, ADDRESS, ENCLOSING BUSINESS CARD,

THE ELECTRIC GAS LIGHTING COMPANY, BOSTON.

Western Office: No. 9, Lakeside Building, Chicago.

ANNOUNCEMENT.

We beg to inform the trade and the public in general, that the

GREAT WESTERN ELECTRIC SUPPLY CO.

was re-organized January 13, 1893, and hereafter will be known as the

Great Western Manufacturing Co.

The following is a list of the combined interests absorbed, owned and controlled by the new organization:

The Great Western Electric Supply Co. of Chicago,
The Western Electric Supply Co. of St. Louis,
Chicago Insulated Wire Co. of Sycamore, Ill.,
Phoenix Manufacturing Co. of Duluth, Minn.,
Bain Electric Manufacturing Co. of Chicago, Ill.

GREAT WESTERN MANUFACTURING CO.,

FACTORIES:
Duluth. Sycamore, Ill.

GENERAL OFFICES:
195-207 So. Canal St., Chicago, Ill.

MANUFACTURERS OF

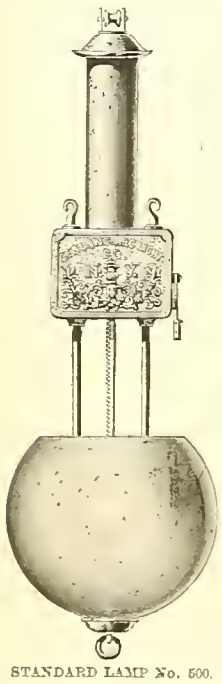
Arc and Incandescent Dynamos, Motors, Mining Locomotives and Electric Mining Machinery, Weatherproof and Magnet Wires, Gas, Electric and Combination Fixtures, Electric Supplies of Every Description.

The "General" Incandescent Arc Lamp.

FOR LOW TENSION CIRCUITS.

The special qualities of superiority in this Lamp are its absolute softness and steadiness of light, small size and weight, simplicity, ease of installation and economy of trimming, thorough insulation and safety, reliability, large range of candle power and length of life.

The Standard Rack-Feed Lamp, No. 500, is 42 inches long, weighs 18 lbs., gives 12 hours of life, consuming 8 amperes of current, and furnishing about 1,000 candle-power of light.



STANDARD LAMP No. 500.

These qualities of reliability, ease of trimming, and agreeable, steady light have enabled the

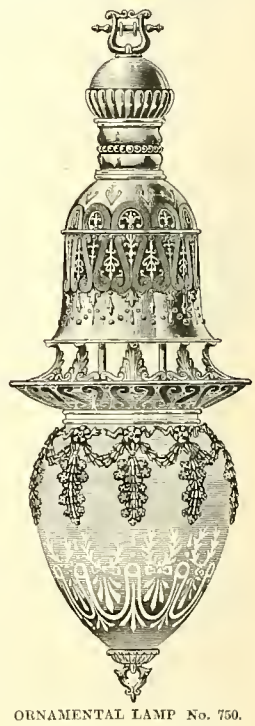
General Incandescent Arc Light Co.

to install these Lamps in many instances in place of electroliers, and have resulted in the production of an extensive and handsome line of

Artistic Designs

which are far in advance of the crude and uninviting efforts that have been made in this direction by other manufacturers, meeting a well recognized but hitherto unsatisfied demand.

The Company's Circular and Price List of the Standard Lamps will be sent on application, and in its handsomely illustrated Catalogue will be found a complete assortment of all styles of Ornamental Lamps as well.



ORNAMENTAL LAMP No. 750.

The Lamps, which are arranged to operate two in series, on a circuit of 100 to 125 volts, are tested and adjusted to the given current before leaving our works, and *any* two lamps marked for the same amperage ***will pair*** at once. Absolutely no adjustment or regulation is required. The Lamps when received need simply to be connected to the outlet wires, and the current turned on. They are trimmed, *i.e.*, new carbons put in, ***without taking off or letting down the globe.***

Discounts on application.

Estimates on special Lamps and Designs promptly furnished.

Correspondence solicited.

GENERAL INCANDESCENT ARC LIGHT COMPANY.

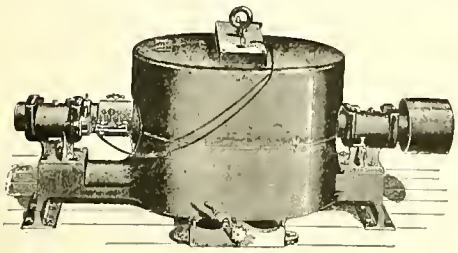
S. BERGMANN, President. C. M. BIDDLE, Vice-President.

WORKS, 33d Street and First Avenue. Telephone No. 1309, 38th St. | GENERAL OFFICES, 59 Duane Street. Telephone No. 163 Cortlandt. | SHOWROOMS, 275 Fifth Avenue. Telephone No. 1459, 38th St.

NEW YORK.

Address All Correspondence to our Works.

THE ROCKFORD IRON CLAD MOTOR.



SIMPLE AND RELIABLE.
HIGHEST EFFICIENCY.
NO EXTERNAL MAGNETISM.

ALSO GENERATORS FOR LIGHT OR POWER.

Rockford Electric Manufacturing Co.,

ROCKFORD, ILL., U. S. A.

RICH GOLD MINES.

I have in my hands two gold mines easily accessible, in the United States of Colombia, South America, with ore of the most extraordinary richness, some of which carries as much as three thousand dollars ($3,000) in gold to the ton, and all being of high grade.

These mines are of ancient discovery, and were worked with great profit for a long period, being only abandoned on account of political troubles before and after the War of liberation.

These troubles have been happily settled for over a quarter of a century, and the Colombian Republic is based upon the theory of and similar to our own government, with civil and religious liberty and equal rights to all, and is as stable as any government in the world.

These mines are so richly endowed with auriferous material, from the easily-worked sand, gravel, and dirt (carrying virgin dust and nuggets), to the fissure veins of free milling quartz, that when properly equipped a profit of ten thousand dollars ($10,000) a day, or over three million dollars ($3,000,000) annually is a very low and conservative estimate.

There is an abundance of timber and unfailing water power, with a genial and healthy climate.

It is proposed to organize this property on a basis of five million dollars ($5,000,000), upon which there can be dividends earned of 60 per cent. or more, and the parties furnishing the original capital, in small or large sums, for this organization, which will be about twenty-five thousand dollars ($25,000), will be let in on a basis of two and a half cents (2½c.) on the dollar, with the privilege of purchasing pro rata at five cents (5c.) on the dollar, a sufficient amount to give them a controlling interest if they so desire.

There is also the right of prior possession to double the amount of contiguous land.

The poverty of the owners of this property, being land poor, is the reason of this unusual offer, and they will retain as much of the property as they possibly can, parting with only what is necessary in order to work it.

Situated in the Jurisdiction of Simite, District of Guamaco, Province of Mompos, State of Bolivar.

An experienced miner who has been over and thoroughly examined the property, says more gold is there than in the entire State of California, while another says so great is the evidence of mineral wealth I sometimes doubted my own sanity, and were I to tell California and Colorado miners even a tithe of what I actually saw, I would be branded as a foolish liar or raving maniac.

L. BRECKINRIDGE CABELL, 53 Broadway, NEW YORK, ROOM 17.

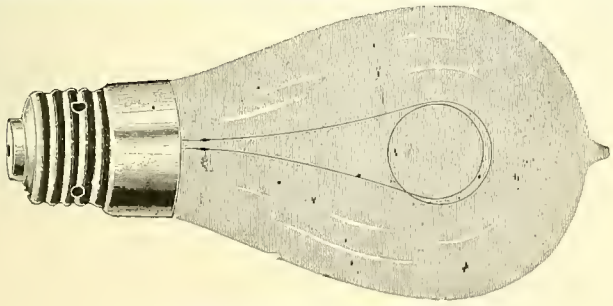
DAY'S KERITE

Day's Kerite.

Highest Grade of Insulation for

Electric Wires and Cables.

CUSHING & MORSE, General Western Agents,
225 Dearborn Street, CHICAGO.

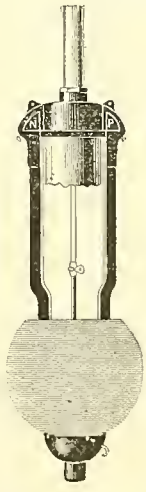


NOTICE.

Western shipments of **"BUCKEYE"** Lamps made promptly from Chicago stock at factory prices.

Voltage, 45 and Upward. Candle Power, 8 to 32.
To Fit all Bases.

THE BUCKEYE ELECTRIC CO., Cleveland, O.
437 "The Rookery," CHICAGO. 611 Mail and Express Building, NEW YORK.



IMPROVED

Interchangeable Arc Lamps

FOR ARC,
INCANDESCENT AND

RAILROAD CIRCUITS.

Waterhouse, Gamble & Co.,

OFFICE: 45 Broadway, New York. FACTORY: Hartford, Conn.

Send for Catalogue and Full Information.

BRILLIANT! BRILLIANT! BRILLIANT!

HIGH GRADE INCANDESCENT LAMPS.

THE ELECTRICAL MFG. COMPANY, OCONTO, WIS.

Lamps for all Systems. Any Voltage or Candle Power.

DIRECT CURRENT LAMPS.
ALTERNATING CURRENT LAMPS.
RAILWAY CIRCUIT LAMPS.

FILAMENTS WITH OR WITHOUT HOOKS.
MINIMUM CURRENT CONSUMPTION, with MAXIMUM CANDLE POWER AND LIFE.

Before purchasing elsewhere send in a trial order for Brilliants.
Lamps furnished to consumers in quantities at factory prices.

AGENCIES: CHICAGO:—Wm. Hood & Co., 239 La Salle Street
MILWAUKEE:—E. C. Mullen, Manager.
THOMASVILLE, GA.:—J. B. E. Love, Manager.

Composed of Asbestos, combined with water and acid proof materials, compressed and vulcanized

FOR ELECTRICAL PURPOSES,

Switchboards, Armature Sleeves, Battery Cells, Insulating Washers, Insulating Parts for Arc Lights, Incandescent Lights, Motors, Chandeliers, Dynamos, Etc. Field Magnet Spools.

Special Styles and Shapes to order. Prices on application.

VULCABESTON

—MANUFACTURED BY—

The Johns-Pratt Co.,

MANUFACTURERS OF

Moulded Mica.

H. W. JOHNS MANUFACTURING COMPANY, - - - SELLING AGENTS,

H. W. Johns' Asbestos Millboard, Sheathings, Building Felts, Fire-proof Paints, Liquid Paints, Asbestos Roofing Etc.,

JERSEY CITY. BOSTON. CHICAGO. ATLANTA. PHILADELPHIA. LONDON.

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W. S. EDWARDS MFG. CO.,

MANUFACTURERS OF

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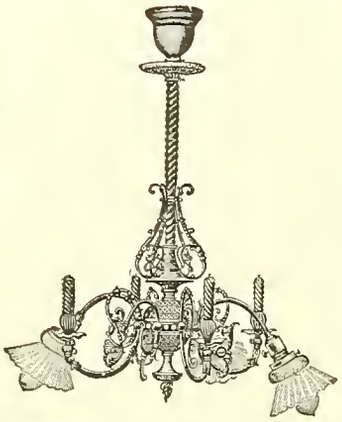
Combination Fixtures,

Electric and Combination Brackets.

EXCLUSIVE DESIGNS.
LOW PRICES.

SEND FOR CATALOGUE.



86 and 88 West Lake Street, Chicago.

INSULLAC

Is the Best Insulating Compound.
It is **WATERPROOF,** does not require **BAKING,** and is guaranteed.

MASSACHUSETTS CHEMICAL CO.,
8 Oliver Street, BOSTON.

J. FRANK DILLONT, Manager, 60 and 62 Broadway, NEW YORK.
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PETTINGELL, ANDREWS & CO., Boston.
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Waterproof Insulating Compounds.
Armature Varnish and Waterproof Insulating Tape.

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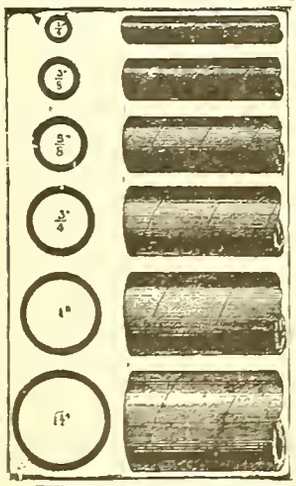
2 Liberty Street, New York. 542 "The Rookery," Chicago.

INTERIOR CONDUITS



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The Solution of the Problem of Safe Guarding
ELECTRIC CONDUCTORS
Wherever and for whatsoever purpose employed, is to be found in the
CONDUIT SYSTEM.

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CONDUITS
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SPEAKING TUBES AND WHISTLES.
Oral, Electric, Pneumatic and Mechanical
ANNUNCIATORS AND BELLS.
FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,
195 and 197 Fulton St., New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.
Send for NEW CATALOGUE. Out August 1st.

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MANUFACTURERS OF

"HERCULES" SWITCHES for Arc and Power Circuits.
"UTICA" QUICK BREAK—ABSOLUTE LOCK—KNIFE SWITCHES for any voltage and amperes.
AUTOMATIC MAGAZINE FUSE BOXES.
SIMPLEX, DUPLEX and QUADRUPLEX LIGHTNING ARRESTERS for Power, Telephone and Lighting Circuits.
MAST ARMS and POLE STANDS.
CARBON BRUSH HOLDERS for Generators, Motors and Dynamos.
CARBON HOLDERS, CIRCUIT JUMPERS and CONNECTORS.
Also General Dealers in ELECTRIC LIGHT and POWER SUPPLIES.

MANUFACTURERS

ORGANIZED 1881.
INCORPORATED 1883.

WARD LAMP

ARC LAMPS

FOR INCANDESCENT AND STREET RAILWAY CIRCUITS.

AN ESTABLISHED FACT: } THE ONLY ARC LAMP THAT WORKS SATISFACTORILY ON AN INCANDESCENT CIRCUIT.

SPECIAL APPLICATIONS:
PHOTO-ENGRAVING, THEATRICAL, AND SEARCH LAMPS.

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

UNITY BUILDING, CHICAGO.
TELEPHONE BUILDING, NEW YORK.

Search Light No. 13.

Westinghouse Electric and Mfg. Co.,

Pittsburgh, Pa.

STOPPER INCANDESCENT ELECTRIC LAMPS.

PRICES.

8	C. P.	$0.30	20	C. P.	$0.35
10	"	.30	25	"	.35
16	"	.30			

DISCOUNTS.

Ten (10) per cent to Central Stations.

Two and one half (2½) per cent. and upward to others, according to quantity.

ALLOWANCES.

Ten (10) cents for every burned-out lamp returned unbroken to factory.

EFFICIENCY.

By reason of an important discovery we now make our 50 volt lamps with an efficiency of 2½ watts per candle. This results in increasing the lighting capacity and earnings of a station

TWENTY PER CENT.

Shipments are now being made.

Detachable bases to fit any sockets five cents net, each.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

ELKHART TRANSFORMERS.

WHITNEY INSTRUMENTS

PARANITE WIRE

ELECTRIC APPLIANCE COMPANY, CHICAGO.

The Osborne Steam Engineering Co.,
ENGINEERS,
Rooms 714-715, 167 Dearborn St., - Chicago
Representative work now in course of construction, 2,000 H. P. Heat, Light and Power Plant for the Pabst Heat, Light & Power Co., Milwaukee, Wis.
Those who contemplate the construction of similar plants on improved and economical lines will do well to communicate with us. First, be sure you will get the best, then go ahead.

H. E. PAINE, Ex-Commissioner of Patents. S. B. LADD.

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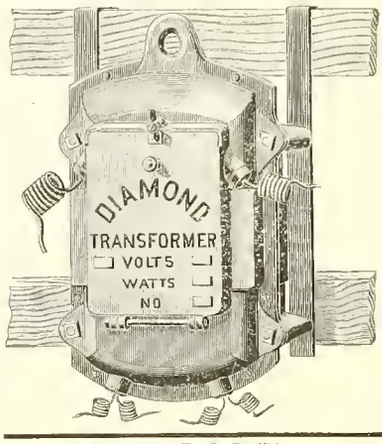

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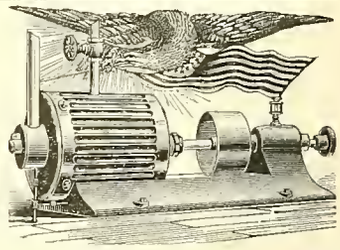

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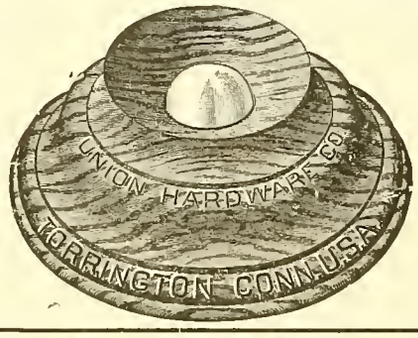

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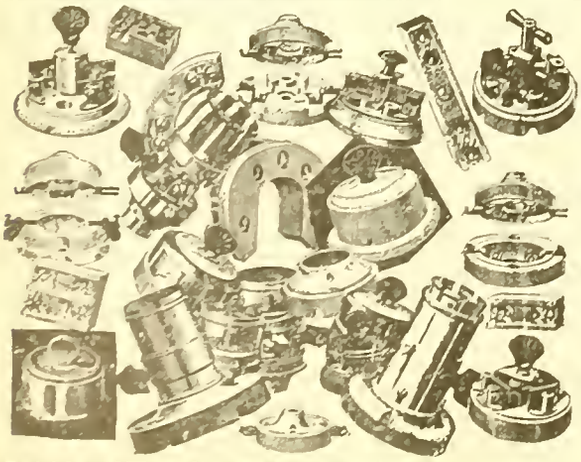

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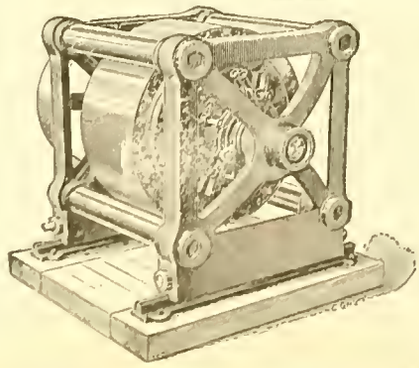

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Western Electrician.

EVERY SATURDAY.

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The Heilmann Electric Locomotive.

The question of attaining high speeds on railroads is occupying the attention of engineers in this country and Europe and has provoked much discussion. Steam engineers generally contend that with the present track construction little advancement can be expected, but there are some who have maintained that many radical changes in equipment will be required before marked improvement is made. One of the most interesting articles on this subject is contributed by Max de Nansouty, in which he reviews the achievements of the steam locomotive and predicts an equally promising future for the electric locomotive. Following is a synopsis of the article:

The steam locomotive caused a wonderful though peaceful revolution at the beginning of the century by changing the conditions of men and establishing more intimate relations. It appears probable that the electric locomotive, which is now being studied throughout the world, will assist in producing a new, and, perhaps no less, important change at the close of this industrial century. Experiments are in progress; our engineers, our electricians, and railroad companies are entering resolutely into the work of producing the electric locomotive. It is interesting at this time to take a survey of the field.

The application of electricity to tramways, although recent, has made wonderful progress. In the United States half the street railways are already equipped; in England the development is becoming rapid; in France we are only at the beginning, but interesting applications are in progress, and this rapid and economical means of transit, has acquired rights in Paris, which was its scientific cradle. From electric traction on tramways to electric traction on railroads is but a step, and electricians have the courage to take it.

A short electric railroad is now in operation in London. In Belgium an electric railroad is projected between Brussels and Antwerp. In the United States, in view of the World's Fair, the Chicago & St. Louis Electric Railroad company has made a complete plan for an electric railroad between St. Louis and Chicago, a distance of 280 miles. In France three important experiments are in progress. J. J. Heilmann has prepared the plans for an application by the State railroad. He has communicated the preliminary plans to the society of engineers and has constructed the experimental apparatus.

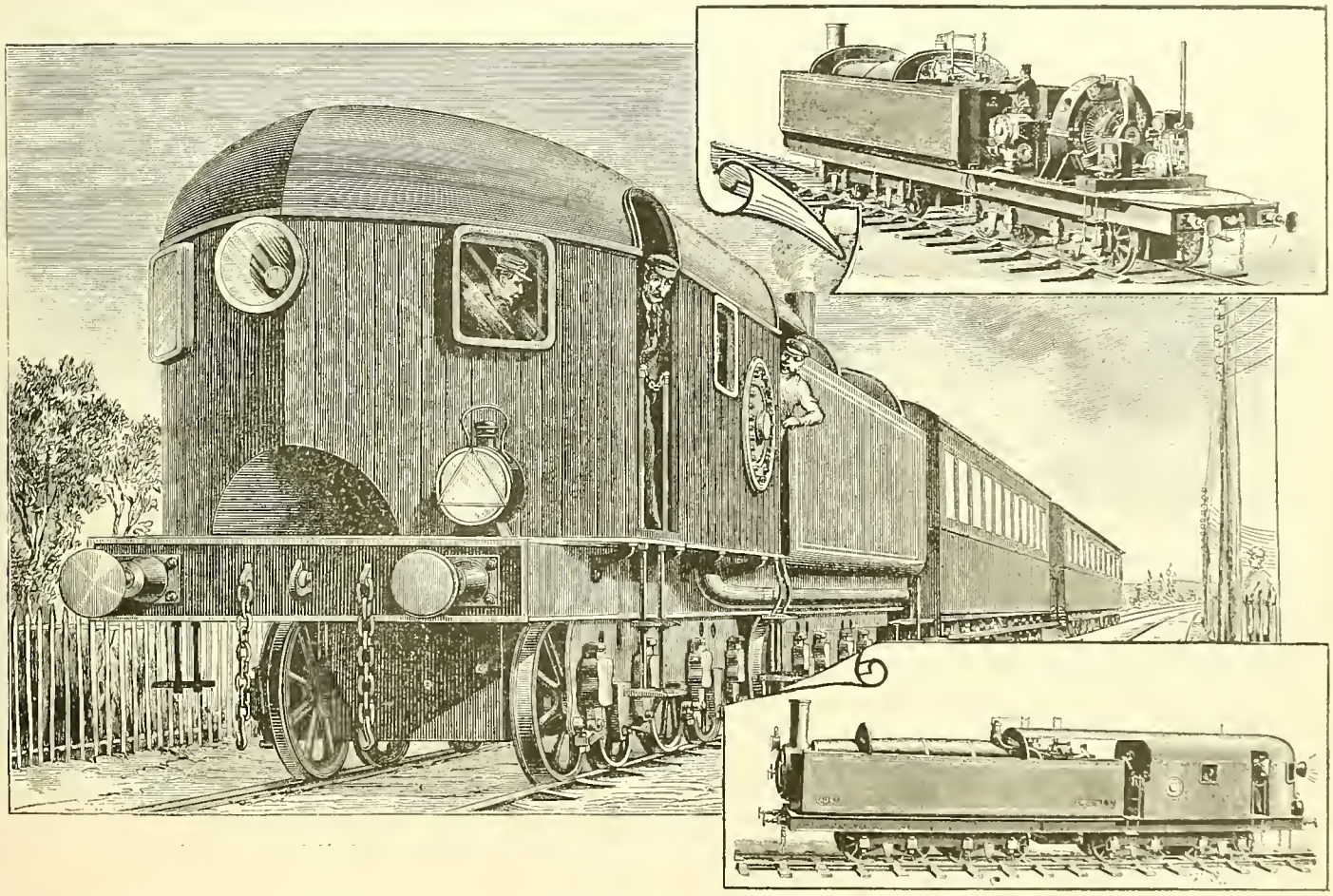
The North Railroad company has made a thorough investigation in the same field, and has built the experimental apparatus under the skillful direction of its chief engineer, A. Sartiaux. For the Paris, Lyons & Mediterranean company H. Bonneau, assistant engineer, and E. Desroziers have laid foundations for this great and imminent change in means of traction.

What are the advantages of electric traction? Why should we wish to substitute it for steam locomotion? Without entering into technical considerations it may be said that the steam locomotive, as we are acquainted with it, is a machine that produces constant work, or almost that, in attaining variable speeds. It is necessary to keep heated the volume of steam which forms the elastic spring by means of which the pistons are moved and motion is communicated to the wheels, and this, too, whether the engine mounts grades, decends them or when it is in a state of rest. The locomotive is then a great squanderer of coal and heat or calories. It is like a horse that eats continually whether it works or rests. We burn thus about eight pounds of coal for a horse power delivered to the axles of a locomotive. If we take this coal and burn it in a station from which we transmit the electric current to a locomotive only at the time when it uses it, then, although the efficiency under the existing conditions might be but 60 per cent. we would use only 4.88 pounds of coal for each horse power transmitted to the axles.

Such is the primary advantage; it consists in the expenditure of only such energy as can be profitably used. Would it not also be possible to make a profitable use of the descents on the line? Assuredly. In descending grades the motors could be operated as generators and thus return to the line a part of the energy needed to climb them, power which is ordinarily lost in the heat due to the friction of the brakes. Electric traction, when electric apparatus is sufficiently perfected, will be economical traction *par excellence*.

But this is not all. The advantage to be gained from the point of view of speed is assured. Electric motors are built directly upon the axles. Turn the current into them, and they revolve, and the axle revolves with them. Every axle, not only of the locomotive but of every car, may and should carry its own motor. And now we have this principle: The speed of the electric train is theoretically unlimited; unlimited we say, for the speed depends directly upon the number of revolutions of the motor attached to the axle, and the motor may revolve at the speed of 1,500, 2,000, 5,000 or 10,000 revolutions per minute.

We may, however, be reassured. Our electricians and engineers have no present intention of launching us into space at cannon ball speed. They modestly content themselves with increasing by half the speed of our fast trains, which now run from 45 to 60 miles an hour. We would make the distance for example from Paris to Marseilles, about 650 miles, in about nine hours, which now requires fifteen hours with our heavy expresses. We could easily



THE HEILMANN ELECTRIC LOCOMOTIVE.

each Nice from Paris in twelve hours instead of twenty-two hours; we could travel from Paris to Lyons in five hours instead of nine hours. This would represent a speed of only seventy-four miles an hour, and that would be an old woman's speed for electricity. But if our road is strengthened and our electrical apparatus is made complete we could readily and practically—yes, practically—double this speed and make Paris only two hours and a half from Lyons, four hours and a half from Marseilles, an hour and a half from Brussels, seven hours from Vienna, fourteen hours from St. Petersburg and sixteen hours from Constantinople. Constantinople will be no farther from Paris than Marseilles now is when the electric express makes 150 miles per hour.

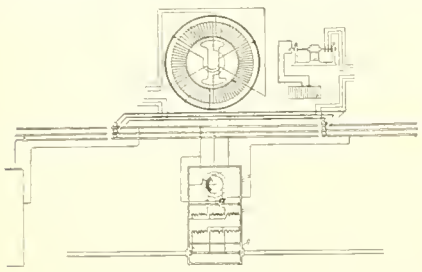


FIG. 3. BADT'S MULTIPHASE RAILWAY AND LIGHTING SYSTEMS.

The principal advantages of electric traction, then are primarily speed and economy. It presents, however, others such as simplicity of mechanism, possibility of reversing direction of motion and almost instantaneous stops; removing the necessity for water tanks and coal supply on the line; brilliant and cheap illumination of trains, the possibility of using water power on the line.

To be sure these advantages could not be realized without material changes in fixtures and rolling stock. Considerable capital must be invested, but the result will be favorable.

What about accidents on the electric railroads? it will be asked. At such dizzy speeds will they not be continual, various and disastrous? Not at all, as theory on the one hand and experiments on the other hand teach us.

Every axle of the electric train in its final and logical form will have, as we have remarked, its own motor. The train, so arranged that no space will be left between coaches for the play of the wind, will form a homogeneous whole, with total adherence of all the wheels to the rails. Instead of the present rolling stock, which wrenches and twists and bends, repercussing and emphasizing the movements of the ponderous mechanism of the steam locomotive, the electric train will glide along keeping tightly to the rails, like a single coach. Except at curves of short radius, where centrifugal force tends to wrench the car from the track, the electric train has no reason for leaving the rails. What generally causes the derailing of trains at present, are the abnormal movements caused by the ponderous mechanism, the high center of gravity of the engines, etc. It is probable, therefore, that we should have infinitely less chances for derailing with the electric train.

There is still the prospect of a meeting of two trains going in the same direction, and one will collide with yours, we will say, and telescope you, as the Americans say. We can be reassured on this point by *a priori* reasoning. On the one hand our trains will be provided with electric brakes so powerful they can be stopped at once. Again, by means of a distribution of current which can easily be designed, an operator could from any station transmit to a train an electric current that would slacken its speed or stop it altogether if the engineer persisted in continuing on the line before the preceding train had passed a certain distance. This certainly would be a complete block system. How shall we produce the electric train whose advantages we have enumerated? Three systems present themselves:

First—Electricity is generated directly on the locomotive by means of steam engine and boiler. This is the system of J. J. Heilmann, which is to be tried on the railroads of the state.

Second—The current is furnished to the electric locomotive by accumulators which are charged at a given station. This is the system of the company of the North and it has been studied by A. Sartiaux.

Third—High tension current generated at stations along the line is transmitted to the locomotive by the rails, which are insulated for this purpose, or by conductors arranged along the line. The current is picked up by brushes. This system has been investigated by Bonneau and Desrosiers for the Paris, Lyons & Mediterranean company. Each of these systems has advantages and disadvantages, and it will not be surprising if they all appear in practice in the course of the revolution that will be brought about in our railroads. These types may all appear, just as we have different forms of perfected locomotives, those with two cylinders, compound, those designed for use on rack roads, those designed for consuming coal or oil, etc.

At this time a brief description of the Heilmann electric locomotive only will be presented. The general arrangement is shown very completely by the engravings. In this system the locomotive is a traveling electric power station. A boiler is carried which generates steam for a Brown engine operating a dynamo, the fields of which are excited by a separate machine. The locomotive is mounted on four trucks the axle of each carrying a motor. The smoke stack it will be noticed is at the rear of the locomotive, and the front end is narrowed somewhat on the form of a prow of a ship.

But it will be said, it is absurd to generate steam on the locomotive, and then transform the energy into electricity, which involves a new loss in efficiency. But there is an error in reasoning here. The heat freed by the combustion of oil in the furnace is better utilized in the form of electricity than when the steam directly operates the pistons of the locomotives. Electricity can be controlled exactly. In addition greater speeds can be attained and the time reduced during which steam is wastefully generated.

The locomotive which is illustrated is not the definitive type; but the tests that will be made with it will be exceedingly interesting and may be considered as belonging to actual practice.

Badt's Multiphase Railway and Lighting Systems.

In the WESTERN ELECTRICIAN of August 27, 1892, there appeared a description of Badt's alternating current

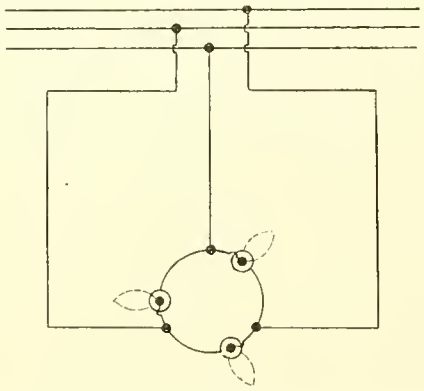
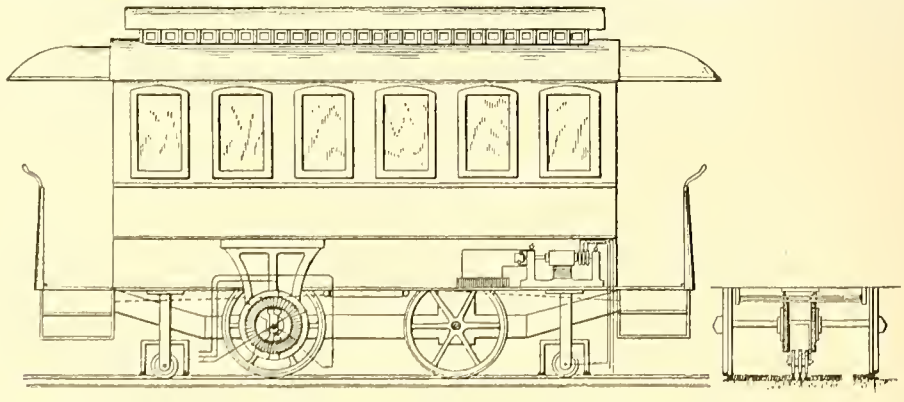


FIG. 5. BADT'S MULTIPHASE RAILWAY AND LIGHTING SYSTEMS.

electric railway system. Lieut. Badt is following substantially the same line in developing what he calls his multiphase railway system, which is illustrated in the accompanying cuts. Fig. 1 is a view of a car partly in section and partly in elevation, showing the general arrangement of some of the features of the invention. Fig. 2 is a cross section through a portion of the car. In Fig. 3 a diagrammatic view of parts of the car and underground system in their relative vertical positions is shown, while Fig. 4 is a diagrammatic view showing one transformer or converter utilized for supplying two or more successive sections of conducting rails.



FIGS. 1 AND 2. BADT'S MULTIPHASE RAILWAY AND LIGHTING SYSTEMS.

In this system, it should be remembered, overhead trolleys and overhead construction of all kinds, are unnecessary; nor is an underground conduit required. The principal advantage claimed for this arrangement is the employment of high tension underground mains carrying from 2,000 to 5,000 volts and thus ensuring a considerable saving in copper for feeders. Assuming a pressure of 5,000 volts for instance, and comparing it with the pressure of 500 volts at present employed in railway systems, the amount of copper needed in the multiphase system would be 1-100 of the amount required in systems extant.

It is proposed to conduct the current to the car motor by surface conductor rails and trolleys underneath the car. The surface conductor rails carry a low tension current, say, not exceeding 50 volts. Insulation is very easily obtainable, as even a partial conductor would insulate sufficiently against such a low voltage. These conductors are divided

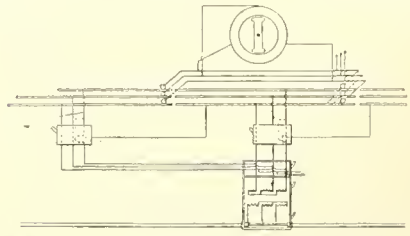


FIG. 4. BADT'S MULTIPHASE RAILWAY AND LIGHTING SYSTEMS.

into sections; each section being less than the length of the car. By a system of either electro-magnetic or mechanical switching devices, only those sections are in circuit which are covered by the car, and the current is picked up from the sections as the car advances and the connections are broken off those sections behind the car.

The track construction need not be changed at all. The rails in which the car wheels travel need not be a part of the electric system, thus doing away with the complications and expenses of electric track construction.

The current is generated by low tension multiphase dynamos at the station and, after being converted through step-up transformers, is sent out at 5,000 volts pressure through underground feeders of small cross-section. This primary high-tension current taps into transformers, which may be located every few blocks and may be easily accessible. From these the current is distributed through switch devices into the sectional conductor rails at low pressure. The multiphase motor, as will be seen by reference to the cuts, comprises a field suspended under the car truck and an armature consisting mainly of a large mass of iron, having no commutator or collector. Great initial torque for starting and speed regulation are easily obtained. Breaks are minimized and repairs easily effected. Every part may be made absolutely waterproof.

The system is also applicable to conduits already in existence. If, for instance, it should be desired to replace a cable system, by a multiphase system the conductor rails instead of being on the surface might be put in the conduit and a trolley arm reaching through the slot of the conduit would make the necessary connections. The same advantages would be obtained, and it would matter little if the conduit were filled with water, as, it is claimed, the low tension employed on the bare conductors on which the trolley moves could not be short circuited by water and would be in circuit only for a short time when the car would be passing. Electrolysis under this condition would not attack the bare conductors.

In this connection the Badt multiphase lighting system may be applied to the cars and stations along the track, allowing incandescent lamps to burn independently of each other and doing away with the objectionable method now employed in street railway circuits, of connecting five lamps in series. This system also allows the use of electric arc lamps as headlights, as the low potential would permit the operation of an electric arc lamp with but very little dead resistance in circuit.

In a multiphase system for incandescent lighting, it is

necessary that every set of wires should be equally loaded so as to maintain an electrical equilibrium similar to that in an Edison three-wire system. Attempts have been made, especially by German inventors, to construct incandescent lamps containing three filaments connected in series within the bulb with three leading out terminals. Each of the three terminals was intended to be connected with one of the wires of a triphase system. It is evident that as in each fraction of a second, one of the filaments would be the common return for the current passing through the other two filaments, all three filaments would become equally incandescent. Another lamp was constructed on the same principle, only three straight filaments were joined in one point with three leading out terminals.

The improvement illustrated in Fig. 5 was designed by F. B. Badt to overcome the objections found in these types, and to enable the use of ordinary commercial incandescent lamps with single filaments and still gain the advantage of always loading the wires of a multiphase system equally. The cut shows the lamp sockets connected in series and each of the wires connecting two lamp sockets attached to one of the wires of the three phase system.

There is a large body of brilliant, hopeful and industrious young men employed in the electric business in this city, says the New York *Sun*. So sudden has been the development of electricity as a factor in practical life that electricians have not had time to grow old, and many of the responsible men in the telephone and electric lighting business are yet below 40. Most of them are at once theorists and experimenters. Every problem presented by the application of electricity to every-day life is now the subject of study by a score of men trained in a practical theoretical school, yet acquainted with the latest discoveries in the science.

The power house of the Central Railway company of Peoria, Ill., which furnished current for five electric lines, was destroyed by fire on January 17th. The fire was discovered at 3:30 A. M. in the machine shop. The men there soon had two small streams on the fire, but neglected to turn in an alarm until thirty minutes later, when the entire structure was ablaze. Henry Riding and Charles Weaver were considerably burned about the face in getting out. The destruction of the building was complete; the loss is estimated at $80,000. The insurance, except on the cars, is $65,000. The company has ordered new generators, and the work of rebuilding the power house has been begun.

Great Western Manufacturing Company.

Next to the incandescent lamp litigation the most important piece of news that has lately attracted the attention of the electrical fraternity is the announcement that the Great Western Electric Supply company, combined with several other manufacturing and supply companies, has removed its factory to Duluth, and engaged in the general electrical manufacturing business, a new company having been formed under the corporate name of the Great Western Manufacturing company. Inasmuch as the new company proposes to cover the entire field, manufacturing and supplying everything from push-buttons to power generators and boldly meeting all competitors, the scope and extent of the new enterprise is deemed worthy of the somewhat extended notice given in this article.

The Great Western Manufacturing company is the result of the consolidation of the Great Western Electric Supply company, the Chicago Insulated Wire company and the Bain Electric Manufacturing company of Chicago, the Phœnix Manufacturing company of Duluth and the Western Electrical Supply company of St. Louis. It was organized January 13, 1893, with a paid-in capital of $1,500,000, of which $1,300,000 is in common stock and $200,000 preferred. All the assets of these companies, cash, stock on hand, raw material, machinery, good will, bills, accounts receivable, office fixtures, patents—in short, assets of whatever description—have been transferred to the Great Western Manufacturing company. The value of these assets has been passed upon by a committee appointed by those constituting the new company, and it was, at a conservative estimate, taken at $1,300,000. The $200,000 preferred stock has been subscribed for at par, $100,000 in cash having been raised by Duluth capitalists and the remaining $100,000 by eastern men.

The history of the consolidated company is interesting. In the spring of 1889 the Great Western Electric Supply company was organized. At first it did a jobbing business only, with headquarters at 190 and 192 Fifth avenue, Chicago. It was not long, however, before the directors of the company realized that for their own protection they must enter the manufacturers' field, and with this end in view space was obtained at 195 South Canal street, and a shop opened there. It soon became necessary to largely increase the manufacturing facilities of the company, and the result was that the entire establishment was moved to its present site, 195-207 South Canal street. In less than two years the company has increased its space three times, and its manufacturing branch has become one of the most important features of its business.

Less than a year ago the corporation became interested in the Chicago Insulated Wire company, and lately has purchased all the stock of that concern. The wire company's history is much like that of the Great Western, starting in a small way, until now it occupies its own buildings in Sycamore, Ill., and has over three hundred machines for the insulation of wire in operation.

A number of representative gentlemen in Duluth, interested in the Phœnix Manufacturing company at that place, opened negotiations with the Great Western company, and after an examination of the affairs of each by committees from the respective concerns, it was decided to unite the varied manufacturing interests of the Great Western Electric Supply company at Duluth in the works of the Phœnix Manufacturing company, and to organize a new company, which should be known as the Great Western Manufacturing company.

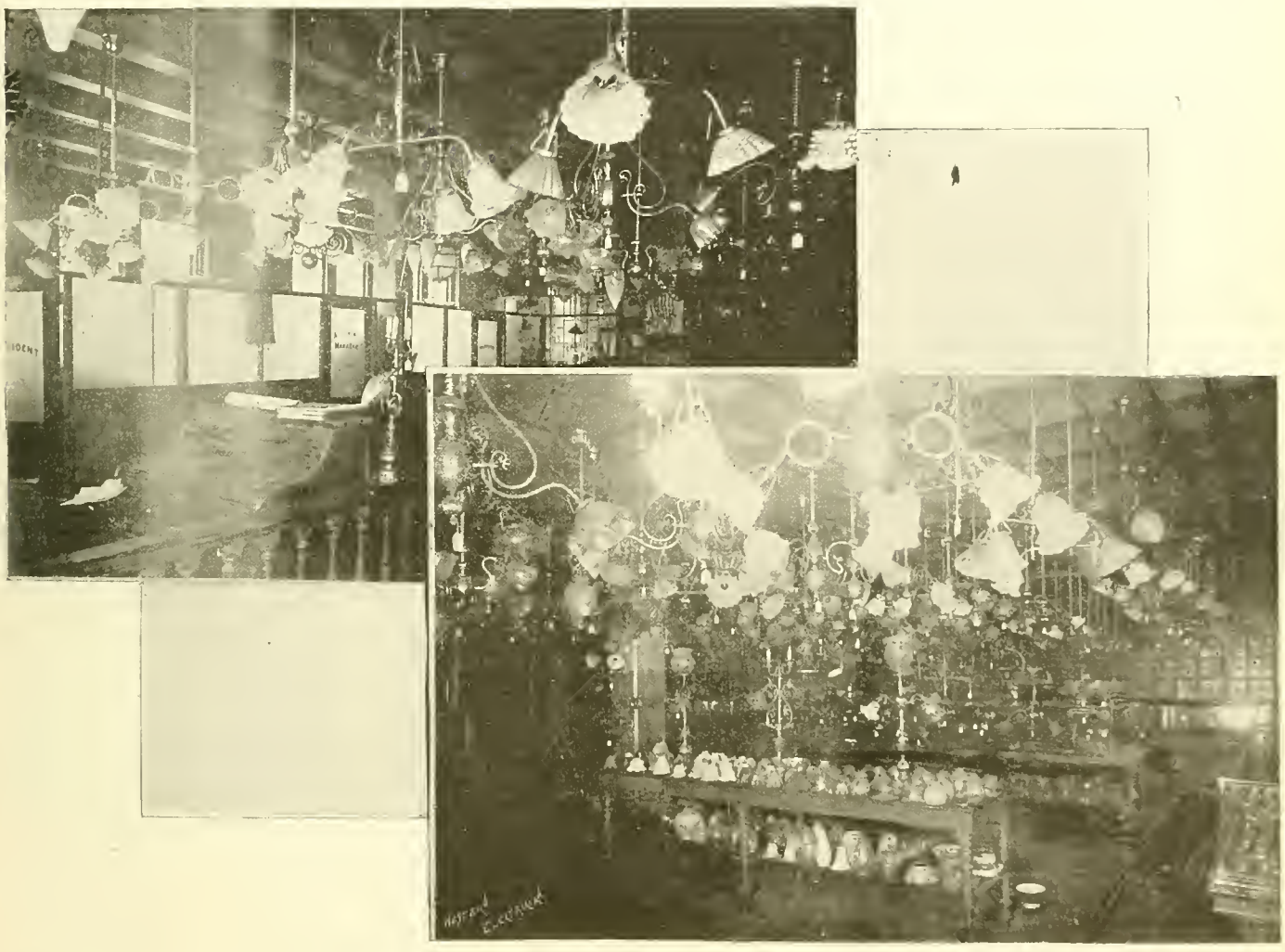


FIG 1. GREATWESTERN MANUFACTURING COMPANY —OFFICES IN CHICAGO.

Later the Bain Electric Manufacturing company was taken into the combination, and preparations are now in progress for the removal of all the machinery, tools and supplies of this company to the Duluth factory, where the manufacturing operations of the old Great Western Supply company are now carried on. The Western Electrical Supply company of St. Louis is the remaining company on the list. This company has for some time been virtually under the same management as the Great Western Electric Supply company.

The officers of the company are: President, T. B. Casey, formerly vice-president and now director of the Northwestern National Bank, Minneapolis, Minn.; first vice-president and managing director, R. S. Munger, president of the Imperial Mills company, Duluth, Minn.; second vice-president, Stephen J. Young, president Union National Bank, Brunswick, Me.; third vice-president and assistant treasurer, O. H. Simonds, general manager Duluth Terminal Railway company, Duluth; secretary and treasurer, H. A. Odell, patent attorney, Chicago; general manager, E. R.

Gilman, formerly president of the Northwest Thomson-Houston company, St. Paul; electrical engineer, Foree Bain.

Among the other stockholders are ex-Governor Merriam, St. Paul, Minn.; H. K. Gilman, Chicago; John L. Dodge, Great Barrington, Mass.; Col. C. H. Graves, Duluth; Judge O. P. Stearns, Duluth; J. D. and R. C. Ray, Duluth; Duncan, Brewer & Co., Duluth; P. McDonnell, Duluth; Joseph Sellwood, Duluth; C. E. Dickerman, St. Paul; J. B. Sutphin, Duluth; E. H. Hall, Duluth; E. G. Chapman, Duluth; Judge J. D. Ensign, Duluth; Myers Bros., Duluth; John Crerar, Chicago; A. Harrington, Minneapolis; H. W. Wheeler, Duluth; Gilliam & Pemberton, Richmond, Va.; Lieut. S. Y. Seyburn, U. S. A., Detroit; Duluth Land & Loan Company; Gen. Robert MacFeeley, Washington, D. C.; Capt. D. Pratt Mannix, U. S N., Washington, D. C.; R. M. Newport, P. T. Barr, St. Paul, Minn.; Eugene Scharff, New York; Phœnix Glass company, Pittsburg; J. H. Gregory, Chicago; R. Park von Wedelstaedt, St. Louis; Edward Carroll, Leavenworth, Kan.; Col. J. H. Gilman, U. S. A., Chicago.

A few words about the officers of the company will not be amiss. E. K. Gilman, the general manager, is well known as the former president of the Northwest Thomson-Houston Electric company. Mr. Gilman entered the electrical field in its early days, and the company which he started in 1887 with a capital of $10,000 had increased its capitalization before he left it, in 1890, to $750,000, and was doing an annual business of several millions, having installed the greater portion of the electric street railways and central and isolated plants in the Northwest. With his wide experience in that company, and later in handling electrical stocks, bonds, and securities, Mr. Gilman is well qualified for his new position. The president of the company Mr. Casey, is widely known throughout the Northwest as a conservative business man and banker. He is a man of large means, and was formerly vice-president of the Northwestern National Bank of Minneapolis. Mr. Munger, first vice-president, is the president of the Imperial Mills company of Duluth, which is said to own the largest flouring mill in the world. Mr. Munger is also interested in many of the leading enterprises in Duluth and vicinity. Hon. Stephen J. Young, second vice-president, is president of the Union National Bank at Brunswick, Me., and is as well known in the East as Mr. Casey and Mr. Munger in the West. He is a man of wealth, conservative, and with exceptional business ability. Mr. Simonds, third vice-president, is general manager of the West Duluth Land Improvement company and manager of the Duluth Belt Line railroad. He is possessed of indefatigable energy and excellent business ability. Mr. Odell, the treasurer, is a gentleman who has had a thorough business training, although a lawyer by profession, and is well fitted to fill his new position.

As will be seen by an inspection of the group of illustrations in Fig. 2, the Duluth factory is thoroughly well equipped for a large manufacturing business. Originally built for the Iron Bay company, the establishment was fitted with every appliance necessary for the manufacture of machinery of all kinds The location is regarded as peculiarly advantageous for the production and distribution of electrical goods. Situated on Bay St. Louis, at the head of navigation on Lake Superior, the factory is within a short distance of the great iron and copper mines of the Northwest, the products of which enter so largely in the manufacture of electrical machinery. Fuel is obtained at an unusually cheap rate, and the shipping facilities, both by rail and water, are excellent, as the tracks on the Duluth Belt Line railway run directly into the factory. E. A. Maginnis is superintendent of the factory, and he has succeeded in putting the establishment in running order

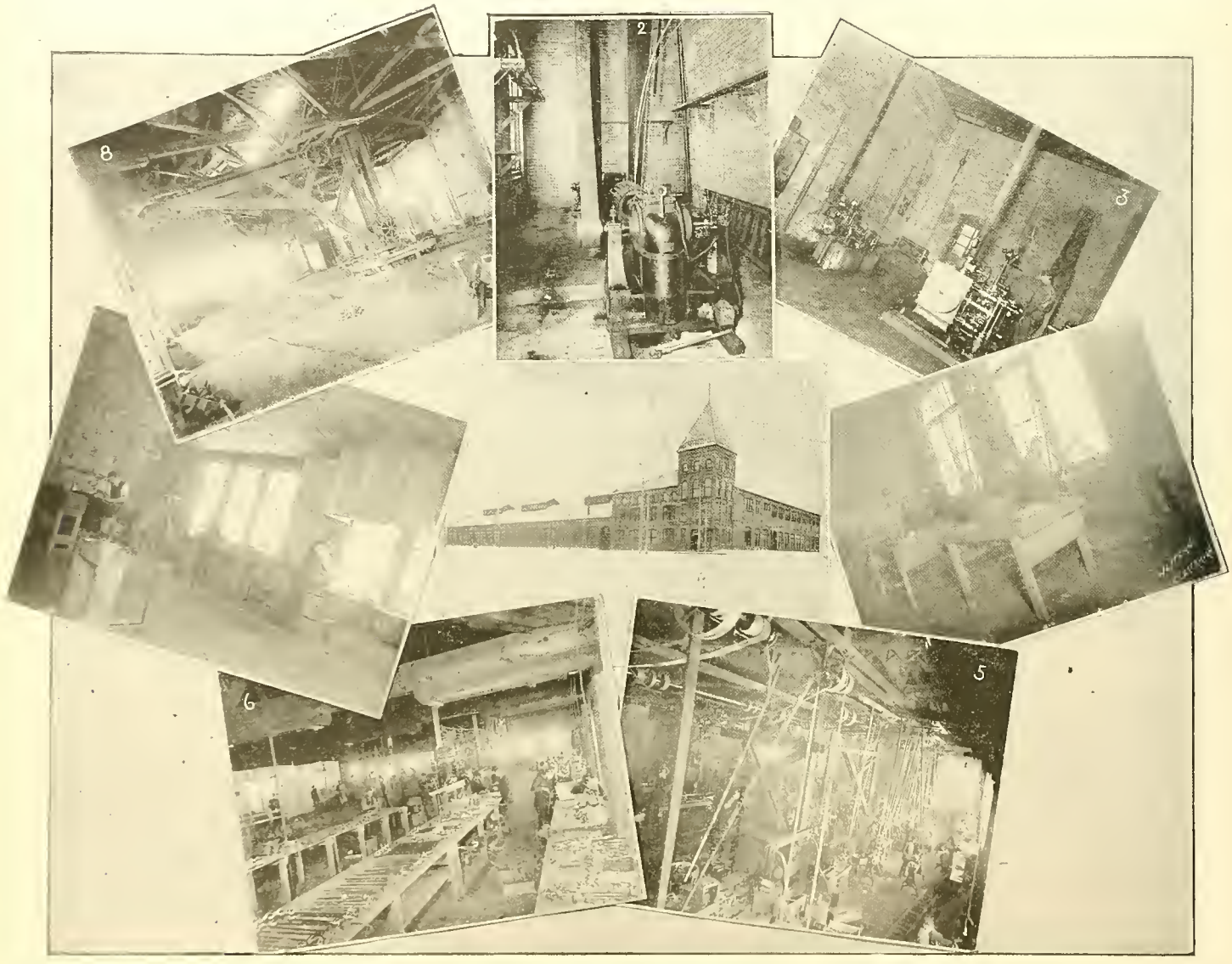


FIG 2. GREAT WESTERN MANUFACTURING COMPANY.—FACTORY AT DULUTH.

1. Exterior View.
2. Dynamo Room.
3. Engine Room.
4. Polishing Department.
5. Machine Shop.
6. Electrolier Room.
7. Plating Room.
8. Foundry.

The general offices of the company are in Chicago at 195-207 South Canal street. Views of the offices and salesroom are shown in Fig. 1.

The business of the company will be carried on much as heretofore, the Chicago and St. Louis houses acting as jobbers for all sorts of electrical supplies, a large portion of which will be produced at the factories in Duluth, Minn., and Sycamore, Ill. H. K. Gilman, for several years the active head of the Great Western Electric Supply company, will be manager of the Chicago office and have general charge of the factories. Mr. Gilman is well known to the electrical fraternity throughout the West, and he will bring to the new company the administrative ability which has contributed so largely to the success of the supply company. R. V. Scudder is the manager of the St. Louis house, and he has already built up a good business in the Southwest. The Chicago sales department and the fixture department will continue in the charge of T. C. Rafferty and J. L. Parmele, respectively.

The plant is located in West Duluth, on the corner of Fourth avenue east and Fourth street north. The principal building, shown in the center of Fig. 2, is of brick, L-shaped, with street frontages of 457 and 200 feet. The corner portion is four stories high with an attic. The wings are respectively one and two stories high and 60 and 75 feet deep. In addition there are two other buildings not shown in the picture. One of these, 200 by 75 feet, will probably be used as a wire factory, and the other, which has dimensions of 175 by 60 feet, will serve as a warehouse.

In the big factory power is supplied by three engines,

one Corliss with 14 by 30 inch cylinder, and two Automatics, with cylinders respectively 6 by 10 and 10 by 20. Steam is furnished by two tubular boilers 16 feet long and 5 feet in diameter, and the plant is rendered complete by a steam pump and feed water heater. There is also a pumping station, equipped with a 20 horse power boiler, Knowles pump and Korting injector, water being taken from Bay St. Louis. The dynamo equipment consists of five machines—a Thomson-Houston 250 light incandescent machine and a Ball arc dynamo of 25 lights capacity for lighting the building, a Sperry 50 lighter and a Thomson-Houston machine of 15 lights capacity for testing arc lamps and a small Eddy dynamo used for furnishing current in the plating room. The factory is completely equipped for machine work, the plant including a 12 ton Walker traveling crane, three 15 ton cranes in the foundry and three 10 ton cranes in the machine shop, 1,800 feet of shafting, about 30 lathes, as well as slotting machines, planers, etc. All the buildings are connected by tunnels. The two-storied wing contains the power plant, machine shop, fixture rooms and plating and polishing departments, while the foundry and blacksmith shop are in the eastern wing. The central portion is devoted to offices, show rooms, stock room and draughting department.

The Great Western Electric Supply company has been manufacturing electric, gas and combination fixtures, arc lamps, and a large variety of electrical supplies. This company's machinery has been moved to the Duluth plant, and the manufacture of these articles is now going on. The machinery, tools and supplies of the Bain Electric Manufacturing company are now being removed to the Duluth factory, and this department of the business will manufacture dynamos, motors, electric mining locomotives, electric mining drills and welding machines, beside electrical testing and station instruments of various kinds. An addition to the factory will probably be built for this portion of the business. It has not yet been determined whether the insulated wire factory will remain in its present quarters at Sycamore, or if it, too, shall be consolidated with the other branches at Duluth. It is expected, however, that it will be moved there at no distant day. It is the intention to put in complete rolling mills early in the summer for the rolling of copper rods and wire drawing.

Foree Bain, one of the best equipped electrical engineers in Chicago, will have charge of the electrical work at the factory, and the Bain dynamo will be the type produced by the company. Mr. Bain has paid much attention to electrical mining machinery, being a pioneer in this field, and the company will devote especial attention to this class of apparatus. Coal mining machinery will be particularly exploited, as Mr. Bain has devised a complete set of machines for this use. The mining generator is especially designed to run for a long period on full or varying load. Constant potential generators and motors will be manufactured in sizes having capacities varying from 10 to 200 kilowatts, wound for any voltage desirable, either shunt or compound. The company will also soon put on the market Mr. Bain's new reciprocating rock drill for quarrying stone. This machine has been quietly but persistently developed for the past year. It is said that when this machine is offered for sale it will be durable and practical in every feature. Within the next year the company will introduce the Bain system of alternating electric light machinery. Contracts will be taken for complete central station plants for lighting and power, with every item of the company's own manufacture.

The insulated wire factory at Sycamore, Ill., is illustrated in Fig. 3. The factory proper is a two-storied brick building 216 feet long and 48 feet wide. There are also two frame warehouses. Nearly all the operations of insulating wire are performed by machinery, and in the factory there are 160 braiders and 142 other machines. These machines are tended by girls and young men, and about fifty hands are employed under the direction of Superintendent F. H. Sydney, who is an expert wire insulator. Most of the manufacturing is done on the first floor, but the magnet wire winders and spoolers, with the stock of cotton, are in the upper story. All the compounds, paints and waxes used are prepared on the premises. The capacity of the factory is from 25,000 to 30,000 pounds of wire a week. Braid insulation is used exclusively except on annunciator wire. Power is furnished by an Atlas 40 horse power engine, which also operates a 200 light Edison dynamo. The factory has only been in operation about a year, but is doing a good business.

Included among the 300 stockholders are many of the representative business men of Chicago, St. Paul, Minneapolis and Duluth. With this strong backing and two well equipped factories, the new company embarks in the general electrical business with bright prospects of success.

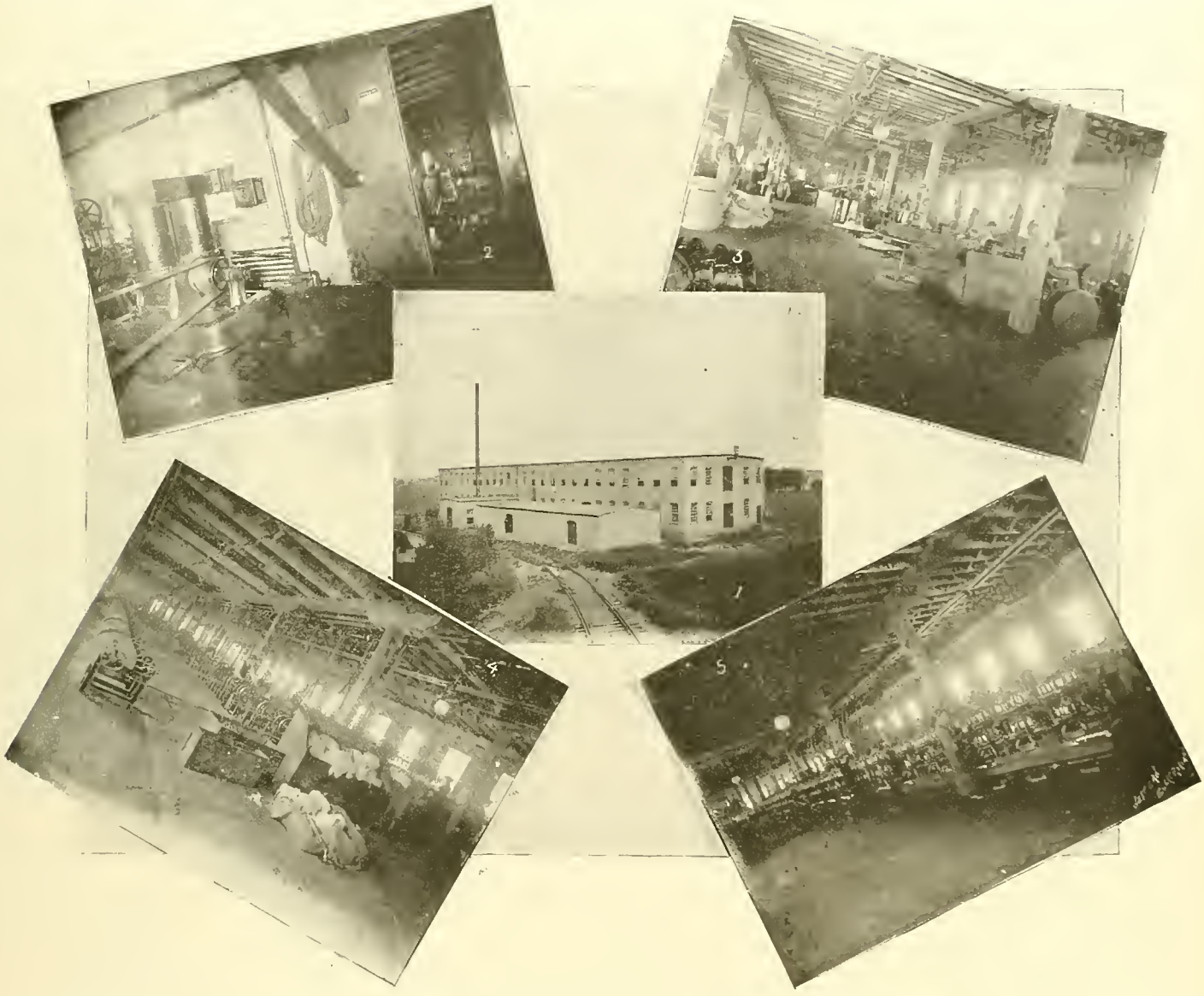


FIG. 3. GREAT WESTERN MANUFACTURING COMPANY.—FACTORY AT SYCAMORE, ILL.

1. Exterior View. 2. Engine Room. 3. Rear View of Braiding Room. 4. Magnet Wire and Stock Room. 5. Front View of Braiding Room.

Nan Wheeler, Willard Warner, C. E. James, Franklin Harris and F. J. Bennett propose to build a new electric street railway in Chattanooga, Tenn.

At a recent meeting in London of the Civil and Mechanical Engineers' society Sidney A. Court read a paper on "Gas Versus Electricity for Illuminating Purposes," in which he drew attention to the need of better lighting of the London streets. He stated that the new high power public gas lamps lately adopted in Westminster and at Hyde Park corner gave only one-tenth the light of a 10 ampere arc lamp, though costing practically the same to erect and maintain. As regards gas, he pointed out that, unless governors are used by consumers, an increase in the pressure in the mains causes great waste of gas, while the burners at the same time give less light, and he stated that at Westminster the pressure in the mains has been known to vary 100 per cent. in the space of one hour. By the Board of Trade regulation the electricity supply companies are, on the other hand, limited to a variation of not more than 2 per cent. either way.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CANDIDATES for political office nowadays seem to consider it necessary to advocate municipal ownership of gas and electric plants and other socialistic principles. In Chicago, for instance, the candidates for the mayoralty nominations are tumbling over each other in their eagerness to "place themselves on record" on this subject. Of course, the mayor of Chicago has nothing to do with the enactment of laws enabling the city to engage in such business, and the candidates referred to know this, but they also know that many of the men who loudly advocate such measures do not understand it, and they are ready, of course, to take advantage of the ignorance of these "reformers."

In New York a bill is pending before the assembly providing for the establishment of gas and electric plants by cities throughout the state. It is not expected that this bill will pass the legislature.

The National Electric Light association should take decisive steps to head off this adverse legislation.

CHICAGO capitalists have formed two large corporations for the manufacture of telephone apparatus, and they have announced their intention of equipping factories for manufacturing telephone devices at once. There seems to be a growing sentiment that the telephone will occupy much more attention during the next few years than has hitherto been devoted to it by the general public. The Bell company expresses confidence in its ability to control the business, especially in the large cities, and some of its more enthusiastic advocates say that by reason of the superiority of its service it will retain a practical monopoly of the business. This belief is not shared by many well informed men and it can scarcely be said that the Bell company enjoys the good will of its patrons. Many of these are asking when the improved service will be introduced and why the company does not adopt complete metallic circuits without charging an extra rental. In many large communities it is claimed that the service is deteriorating. It is not to be wondered at, then, that capitalists, knowing the feeling that exists toward the old company, should readily invest in concerns that are formed to equip competing exchanges. It may be expected that the year 1893 will mark an interesting epoch in the history of telephony in America.

CABLE dispatches announce the opening of the Liverpool electric railway by Lord Salisbury on February 4th. The road is the first elevated railway built in England. It will be used entirely for passenger traffic and a high rate of speed will be attained. It was only the promise of immediate relief for a very much overcrowded district that secured the consent of the English to the construction of an elevated structure. It will be noticed, however, that while the elevated structure was accepted the steam locomotive would not be tolerated. This is certainly the proper spirit, and New York, Chicago and other large American cities should take a lesson from the city of Liverpool. It is certainly a most outrageous policy to allow the use of steam locomotives with the accompanying smoke, cinders, dirt and noise, through the heart of a large city. New York has had an opportunity to secure some relief from this nuisance by the adoption of the underground system advocated by the Rapid Transit Commission. But New York with its boasted enterprise could not find enough public spirited citizens to undertake the construction of this road. Chicago took a step backward when the use of steam locomotives was decided upon for the South side "L" road. Electric motors should have been adopted. It is now announced that the Metropolitan Elevated Railway company, which will build the big "L" system on the West Side, Chicago, is contemplating the adoption of steam locomotives. The people should object to this outrageous decision. There is no excuse for the use of dirty, noisy steam locomotives for this work, and the company should be compelled to adopt the electric motor.

REVIEWING the progress of electrical engineering during the last year in Great Britain, London *Industries* says that "commercially, the electrical industry has been by no means flourishing." The development did not meet the expectation of manufacturers. Continuing it says: 'In 1891 the demand for electrical machinery was very great, and works were in many cases enlarged. In 1892 many firms were very fully employed, but, on the whole, there has not been so much activity in electrical work. Central stations, corporations and local authorities are very active just now and the pendulum is swinging over in favor of municipal electric lighting." The same journal expects that much good will come from the Crystal Palace Electrical Exhibition, which made "electric lighting more and more familiar to the minds of town councilors and the public generally." Central station managers seem to have increased the capacity of their plants, and the demand for lights, both arc and incandescent, shows a growing sentiment in favor of the improved method of illumination.

Our French contemporaries, unlike the English, seem well satisfied with the accomplishments of the last year, and extremely hopeful of what the present year will bring forth. They admit that there has been nothing startling in the line of invention, nor has there been any particularly bold engineering project presented, but there has been material advancement, and new fields have been opened which give promise of rich rewards. In his review of the progress made during the year 1892, E. Hospitalier calls attention to the fact that in making and laying great ocean cables, France is no longer dependent upon England. This, of itself, is enough to gladden the heart of every Frenchman. Much interest is manifested throughout the old world in the project for utilizing the power of Niagara. But our European friends are looking forward to the opening of the Columbian Exposition at Chicago as the most promising event of the year, and in this they will not be mistaken. As an object lesson, in which the best American practice can be compared with European methods the World's Fair will be particularly attractive to foreign engineers. Then, too, the Electrical Congress which will meet in Chicago during the exposition will be another attraction. No wonder the French engineers look to America this year with particular interest.

ADDITIONAL information relative to the sale of the Green electric railway patents to the General Electric company appears to confirm the report of the transfer, which was noticed in the WESTERN ELECTRICIAN last week. It is now stated that, as the result of negotiations conducted by F. B. Fish, counsel for the General Electric company, the purchase was consummated about two weeks ago. O. S. Kelly of Springfield, O., was the vendor, he having come into possession of the patents several years ago.

The Green patents have already had a checkered career. The original application of one of the patents was filed on September 15, 1879, and the patent thereon was issued December 15, 1891, pursuant to a decree of the Supreme Court of the District of Columbia, overruling the commissioner of patents in rejecting the application. The inventor was George F. Green, a resident of Kalamazoo, Mich., and at the time of filing his application, it was alleged, he was too poor to employ an attorney to assist him in its preparation and prosecution. Owing to his unfamiliarity with patent matters, the application prepared by himself did not meet all the requirements of the patent office, principally on account of his failure to use technical terms and language in describing his invention, and as aresult the patent was delayed twelve years. His invention was pronounced patentable, but after a long period of suspension, awaiting his turn to be placed in interference with applications of Prof. Thomas Ball and Stephen D. Field of Massachusetts, Thomas A. Edison and Prof. Siemens of Berlin, who claimed the same invention, the patent office refused to admit his application to the interference for technical reasons, and a new application was required. The interference, it is said, was also decided against him on a narrow construction of the issue, and a patent was issued to Field covering what the patent office construed to be the specific patentable matter. But Green's claims covering the broad matter were persistently prosecuted by way of appeal to the Supreme Court of the District of Columbia, and the latter tribunal overruled the patent office, thus securing to Green the claims for which he had been so long contending. The principal claim of the patent that dates back to 1879 is as follows:

The combination of a railway track, one or more stationary means of electric supply, electrical conductors extending from said means of electric supply along the lines of said track, and consisting wholly or in part of the rails thereof, vehicles moving along said track, electro dynamic motors whose coils are constantly excited so long as the poles of said motor are in circuit with the means of electric supply fixed upon said vehicles for imparting motion thereto, and wheels supporting said vehicles upon the track, and also serving to maintain continuous electrical connection between said means of electric supply and motors.

There is also a patent for which application was filed May 15, 1886. Its leading claim is thus set forth;

The combination of one or more sources of electric supply, a railway track, a wheeled vehicle moving upon or along said track, a conducting circuit composed wholly or in part of insulated conductors extending along the line of travel of said vehicle, one or more rotating electric motors mounted upon said vehicle for propelling the same and included in said circuit of conductors, and a circuit controller placed on said vehicle, and also included in said circuit of conductors.

Mr. Kelly, who has just been bought out by the General Electric company, tells the following story of his connection with the litigation:

I met Mr. Green in 1883 in this city [Springfield, O.]. Mr. Green told me of his invention of the electric street car system. For a certain consideration I took an interest in it; and in addition was to pay all expenses connected with the case. Mr. Green made his application in 1879, and when I arranged with him in 1883 his patent was still suspended. We waited until 1886, at which time the patent office granted letters patent upon electric railways to a nephew of Justice Field. I then asked to put in an interference, but the patent office, by unusual ruling, held that I could not come into interference with Mr. Field unless I filed an entirely new application, doing it in 1886. I filed the application and fought it through, but in 1889 Mr. Field was granted a patent on part of Green's invention. In the meantime I had kept the '79 application alive and we came to them with it. They, however, rejected us. Then we carried it to the supreme court and they granted us the patent. In the meantime I bought out Green.

It will be seen that the claims of these patents cover broadly the general principle on which all the overhead trolley electric railroads in the United States are operated, and it is stated that the General Electric company believes that it possesses the absolute ownership of all known methods of conveying current to electric cars. It cannot be doubted that the recent purchase of the patents cost a large sum of money, which the General Electric company would not have expended unless it was advised that the patents stood an excellent chance of being upheld by the federal courts. Taking this fact and the action of the company on its incandescent lamp patent into consideration, it seems fair to infer that the General Electric company will soon take steps to establish its claim, and that a legal battle of the first magnitude will ensue. Interests of great importance are involved, and further steps will be awaited with eager interest.

German Electric Elevator.

A German electric elevator equipment with some novel features is shown in the accompanying illustration, Fig. 1. It is manufactured by the Allgemeine Elektrizitaets Gesellschaft of Berlin, and is made for capacities of 500, 1,000 and 3,000 kilograms.

The motor is of the multipolar type made by this firm, and is fastened to the same bed plate as the hoisting mechanism, which is connected with the motor by a worm on a prolongation of the armature shaft. This worm engages in a gear having an axle in common with the hoisting drum. Wire rope is used and the usual precautions and safety devices are made to allow for a sudden parting of the cable. In direct connection with the driving shaft is a brake device which is set in operation when the operating lever or wheel points at "halt."

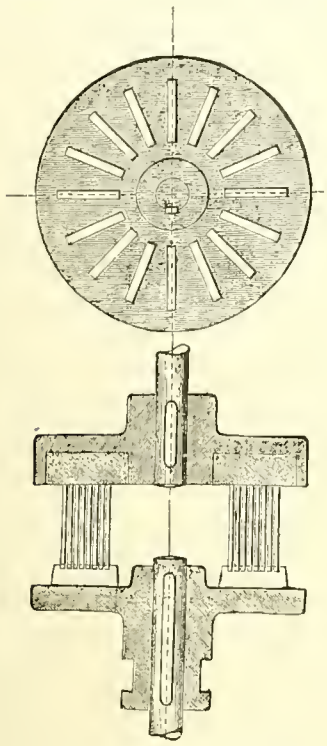


FIG. 2. GERMAN ELECTRIC ELEVATOR.

While it is necessary to set the hoisting drum in motion with the least loss of time, it is nevertheless imperative that its motion be easily checked, and although this also must be done quickly, yet it should not be accomplished so suddenly as to sprain the parts or to reverse the drum's direction of revolution. To accomplish this an elastic device, Fig. 2, is connected between the armature and brake. This consists of two coupling disks mounted on the same shaft. One of these disks has fastened to it bunches of flat steel wire resembling brushes; the other disk is provided with radial projections of steel corresponding in size and position to the steel "brushes" of the other disk. The two disks are set at such a distance from each other that the steel brushes of one overlap the projections of the other by from one to two millimeters. In the ordinary operation of the elevator the brushes of one disk carry along the other disk with it. Now if the load should increase beyond the normal capacity, or if something should suddenly interfere with the running of the mechanism, the steel brushes would bend more and more until they would at last wipe over the projections on the other disk and no longer revolve this latter with it. An arrangement of this kind can be used to operate at any load, and can even be used in starting up slowly; that is, by allowing the motor to run empty at full speed and then gradually throwing the load on, instead of throwing the load on the motor simultaneously with starting it.

It is to be noted here that the driving worm, in order to gain greater efficiency, is cut with a very great pitch, and indeed to such an extent that it is not self-locking—a condition that would permit of its running down. To prevent this, when the elevator begins to descend, the shaft of the worm revolves the armature of the shunt motor, in which current is generated in direct proportion to the velocity of the car, so that any extraordinary speed in the descent is checked and the elevator is allowed to drop at a fixed velocity.

A further safety device is connected with the hoisting drum itself. This consists of a disk which by means of a lever and weight is constantly pressing against the vertical face of the drum, and opposing its action. As soon as the current is turned in on the motor a large magnet in shunt with the motor is energized and relieves this friction on the drum. If the motor is cut off by accident or design, the lever with its weight comes at once into play and brakes the drum. The cuts are from the *Elektrotechnischer Anzeiger*.

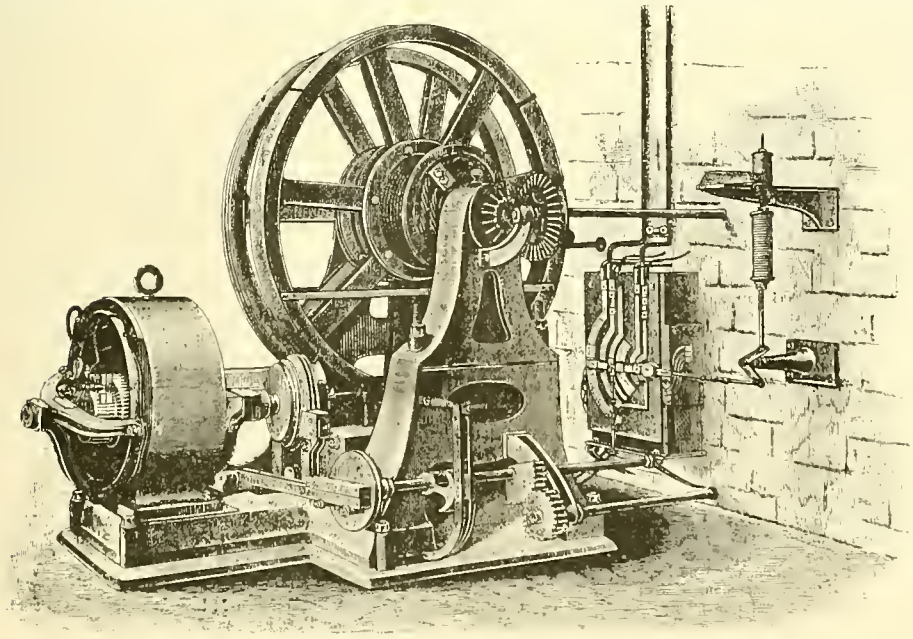


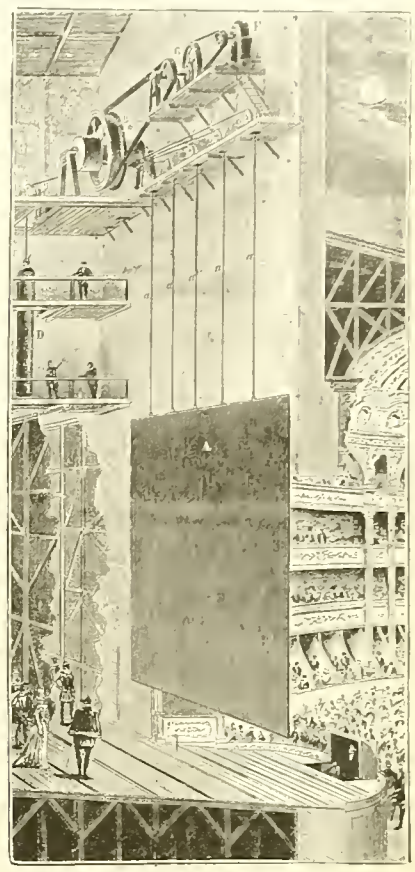
FIG. 1. GERMAN ELECTRIC ELEVATOR.

Extensive Railway Scheme for Providence.

The Union Railroad company proposes an extensive system of electric railways for Providence, R. I. Within a year it must equip all its lines in the city with the trolley system of electric traction. This is one of the conditions upon which the permission to run electric cars has been granted. The first ordinances permitting the company to operate cars by electricity were approved October 11, 1892. These were for the Elmwood and Pawtucket routes. By various ordinances passed between the date mentioned and December 6th all the lines in the city were directed to be fitted for electric power. Before this the company had been authorized to locate and equip an electric road for the accommodation of the residents of Fruit Hill and North Providence. These people threatened to construct a road of their own, and an agreement was entered into by which the local corporation agreed to establish an electric route which should run down Smith street and join the other North End tracks. In East Providence the Union company has been granted a valuable franchise, by which a monopoly of the traffic between the city and the East Side shore resorts may be secured. This furnishes an indication of the work which the present corporation or its successors must accomplish before the 1st of January, 1894, and it may also be said that the East Providence rights form an important link in a possible chain that may ultimately extend to Fall River and New Bedford, and possibly Newport.

Electrically Operated Stage Curtain.

For two months the curtain in the Comedie Francaise theater in Paris has been raised and lowered by electricity. The installation, which was made under the direction of the Edison company and the chief stage carpenter of the theatre, is said to be the only one of the kind in Europe. The illustration represents very completely the plan which was followed. The curtain, *A*, which weighs about 1,170 pounds, is suspended by five ropes *a* which run over the pulleys *O* and wind round the drum *B*. The weight of the curtain is balanced by a counter weight *D*. When it is desired to raise the curtain, current is switched to the 2 horse power electric motor *F* connected by countershaft to the drum *B*. The curtain is operated from the prompter's cage in the front of the stage, as the engraving shows. It travels a distance of 31 feet, and the rheostat is so arranged that the curtain may be raised or lowered at the rate of 2½ feet, 3½ feet or 4 feet per second. Current for operating the motor is taken from the Edison circuit from which the theatre is lighted. It is said that the installation gives entire satisfaction. The illustration is reproduced from *La Nature*.



ELECTRICALLY OPERATED STAGE CURTAIN.

Electricity at the World's Fair.

A circular has been issued from the department of electricity asking exhibitors for information as to the number of packages in the shipment of exhibits, the number of shipping labels and tags required and the probable time of shipment. Tags and labels will be furnished immediately upon application, and the department urges upon exhibitors the necessity for early shipment of exhibits in order to avoid the inevitable rush of the last few weeks of the installation period.

Ample telegraphic facilities will be provided on the World's Fair grounds. The lower floor of the southeast pavilion of the administration building will be devoted to the telegraphic service. The Western Union will have a space of 40 by 60 feet at the southeast corner; the Postal will take the northeast corner. Here will be located the general fair offices of the two companies. On big days, when the demand of the newspapers will be heaviest, the Western Union expects to be able to handle 40,000 words for afternoon journals. It is expected that correspondents for morning papers will not use the service at the fair to any great extent, but will go to the down-town offices. As at present determined the Western Union will have branche

in the following named buildiogs: Machinery hall, the casino, two in the manufactures building, the electricity building, the transportation building, the railway station, the horticultural building, the government building and the Illinois state building. It may be that another office will be located among the state buildings. The Postal company will have branches in the electricity building, the casino, machinery hall, the mines and mining building, two in the manufactures building, the New York and Illinois state buildings, and at the Sixty-third street entrance.

Beside handling messages the Western Union will supply time for the fair. At convenient places in all the buildings and at the state headquarters will be placed self-winding clocks of ornamental design. The master clock for the 200 or 300 clocks of this character on the grounds will be located in the manufactures building, and will be regulated from the Washington Observatory.

The exhibits of the telegraph companies will be in the eastern gallery of the electricity building. The Western Union company will have a handsome booth, 50 feet long and 12 feet high, with six ornamental columns. On the wide cornice will appear the words, "What God Hath Wrought." The first telegraphic message ever sent in the world thus will be commemorated. The crude instruments with which S. F. B. Morse ticked out this message will be in the booth beneath. Beside them will be the perfected quadroplex instruments of the present. If Morse was the father of telegraphy, Cyrus W. Field bore the same relation to ocean cables. The fame of both will be honored by memorials in the Western Union booth, consisting of portraits, medals and other interesting mementos of these two pioneers. The model of the steamship Great Eastern, which laid the first successful Atlantic cable, will represent the early days of ocean cables. Beside it will be displayed the modern appliances for putting down and repairing cables.

The Postal company will also make a fine display.

In responding to the question, "Is Great Britain contributing much to the electrical section?" put to him by a London interviewer, Sir H. Trueman Wood, British commissioner to the World's Fair, said: "Not so much as I could have wished. English electricians have had rather a surfeit of exhibitions lately. The chief exhibit will be a splendid collection of apparatus in use for the purposes of telegraphy by our postoffice. I may add that there are some specimens of platinum, etc., in the mining section."

Free Wiring.[1]

By J. M. Campbell.

When arc lighting was first introduced in this country it was customary to put lamps and wires into the premises of the consumer free of charge. As the business increased and incandescent systems of lighting were introduced this practice was in a great many instances continued. The simple wires of the arc system multiplied in number and size. The labor of installing plants increased greatly, a better insulation was called for, incombustible fittings and better workmanship were the order of the day; until at the present time if interior wiring for any incandescent system is put in properly, it requires good material and good workmen. Both of these cost money. In the face of all this, a great many of the local lighting companies wire up places of business and houses free of expense to the owners, charge the outlay to "capital account" and post it up in their books as an asset. The stockholders at the end of the year very likely obtain a stock dividend and may consider themselves very fortunate if they are not called on to subscribe for a further issue of stock for extensions and improvements, unfortunately improvements to the property of others, and which if an asset at all to the lighting company doing the work, are of a very doubtful character—the kind of an asset which should be written off the books every year as a dead loss. Where do we hear of gas companies piping up customers' premises free of charge? This is seldom if ever done, and yet in small towns the gas making industry does not seem to be any great bonanza, and it is generally conceded that gas can be supplied cheaper than incandescent electric light.

No doubt when an electric lighting plant is installed in a town a greater number of customers can be obtained by supplying all interior work free of charge, but when this is done the company is at the mercy of the consumer. On the slightest pretext the company is ordered to take out the lights and wires by the consumer, who has no financial interest in the stuff, and the company's asset of so many lights wired up becomes a scrap heap of very little value. If the customers put in their own interior work, it saves a large outlay to the company in the first place. They then have an interest in it and will not be inclined to cut off the current without good reason. When pay-day comes around the collector will find that he has a different man to deal with than our friend with the free wires. By abolishing free wiring a better class of customers will be secured. The lighting company's expense will be cut down considerably, as all changes and repairs can be charged for. There will not be so much capital invested, and therefore less dividends to pay, and on that account, a cheaper service can be given. Give the people a perfect service at as low a

[1] [illegible] at Toronto January [illegible]

figure as possible, and make them pay for everything inside of, and including, the main line cut-out.

The company may not secure quite as much business, but it will show a much greater net gain at the end of the year. The business will increase much quicker than the capital account, and by and by when a street circuit must be extended or a new dynamo put in, the money will be on hand which would otherwise have been squandered on free wiring.

Electrical Recording Meters.

By Caryl D. Haskins

Part III.

We may now turn from the consideration of the clock and separate motor meters, and give our attention to what is to-day the most important class of electrical recording instruments—the motor meters, those whose registering train is actuated by the current to be measured. There are quite a large number of meters of this class, although invention until recently has not been as prolific in this particular direction as in the clock meter field.

In the majority of cases, motor meters have been designed for alternating circuits, and these again naturally divide themselves into two classes, those actuated by inductive principles, and those whose motive powers act directly, and which are similar in character to the electric motor. Of the first class there is a large number, designed, of course, for alternating circuits.

These are almost exclusively of two forms—the wound and the unwound armature types. But few, if any, of the former are in practical use, though several have, I believe, shown very fair results. As a rule, they consist of a field formed of a coil or coils in series with the lamps, and a small drum, or other closed circuit armature, preferably without iron, whose commutator is short-circuited across, by directly connected brushes or other similar means. This meter will record with considerable accuracy, but in the presence of better and simpler plans, it has not met with general favor.

The other class of inductive meters is, in its various forms, very familiar to almost every one. It consists, in general, of a coil or coils, in series with the lamps forming the primary. A short-circuited coil of low resistance within and at angle to this forms the secondary, and within this again is a more or less solid metal armature of disk, drum or other shape, generally wholly or in part of iron, and mounted on a carefully balanced shaft, which, on rotating, actuates the recording dial.

Meters of this construction, while highly practical and decidedly useful, are scarcely all that could be desired for several reasons, all of which tend to introduce errors. In the first place their construction and principle prohibit entire accuracy on very low readings. This is quite largely due to the fact that nothing is present to balance friction.

Now the theory of meters as set forth in most of the patents on file claims a torque proportional to the square of the current, which doubtless would be correct, could we neglect the effect of certain minor influences. In reality, careful tests seem to show that torque falls somewhat below the square, and above the direct proportion, and the proportion does not seem to hold good at various points of load.

The speed of motor meters is naturally approximately proportional to the torque, and they therefore tend to run too fast and have to be restrained, which is accomplished in various ways, as we shall presently see, while discussing the question of drag or damping mechanism.

None of the inductive meters will run on direct current, of course. We now come to the second form of motor meters—those which are not dependent upon inductive action for their rotation, and are consequently equally serviceable for alternating or direct circuits.

Of these there are but a few, all of them having a field in series with the lamps and an armature—sometimes in series and sometimes in shunt. Of the former kind but few have been tried carefully enough to thoroughly prove their merits.

Perhaps the most successful of these has a heavy iron field, with resultant poles above and below a shallow basin of mercury. The current for the lamps passes through a copper coil around, and excites the field, thence through the mercury from a portion of its periphery to the center, or *vice versa*. This naturally causes the mercury to rotate, its speed being proportional to the amount of current, minus, of course, the effect of friction, the mercury in this case forming the armature.

Friction is balanced in this meter quite successfully by the introduction of a fine coil of high resistance around the field. This coil is "in shunt across the line," and serves to intensify the field on the lower readings, while on the higher ones it bears too small a proportion to the total field to exert any appreciable influence. This coil can be nicely adjusted to balance friction, by varying an outside resistance.

While such a meter has many weak points, still it has one marked advantage, the balancing of friction. This cannot be given too great importance in motor meters, for friction is their weakest point, and by successfully neutralizing this, they may be brought to almost any degree of accuracy, provided always that their fundamentals remain proportional throughout.

The remaining class of motor meters embraces those with a series field and shunt armature. These are somewhat of a departure from the others, since they are not current meters, but power or watt meters. Their construction is in all cases quite similar to an ordinary shunt motor, the conditions of field and armature being reversed.

The field is in series with the lamps; the armature, which is of high resistance, and generally of Siemens construction, with a commutator of a few segments, is placed "in shunt across the line," the shunt being taken off beyond the field coils. An outside resistance is placed in this shunt circuit, to reduce the current in the armature to the necessary small quantity and to prevent any appreciable waste across the line.

The strength of armature, then, may be seen to be dependent on the pressure, while that of the field depends on the expenditure of current. The torque of this meter, then, is directly proportional to the power passing, and the speed is naturally proportional to the torque (again minus the friction), but the friction is balanced in these meters, as in the previous one, by the presence of a "shunt field," since the armature circuit is taken off beyond the fields, and consequently passes through them in addition to the current for the lamps. As in the previous meter, this serves to counteract the retarding influence of friction in the lower readings, where it is dangerous, while in the higher ones it bears so small a proportion to the total field as to be unappreciable. This meter is, of course, equally useful without any change of calibration on either a direct or an alternating current of any frequency.

Motor meters, as a class, rotate far more rapidly than is allowable in practice. It has been found necessary, therefore, to introduce a "drag" or resistance to rotation, to slow the meter to a reasonable speed. This has been done in several ways; perhaps the most common method being to attach to the shaft a number of air fans. These are quite largely used, and with fair success. The resistance of an air fan to rotation is approximately proportional to the square of the speed. Therefore this device is only fitted for combination with such meters as have a torque increasing with the square of the current. But since the torque of such meters does not quite reach the square, the retarding effect increases rather too rapidly and has a tendency, though not always pronounced, to cause the speed of the meter to fall off proportionately on high loads.

An effort has been made to overcome this disproportion of the fan's resistance by substituting folding fans which close by centrifugal force, on the principle of the steam-engine governor. This novel idea, while a decided improvement, scarcely overcomes the difficulty.

Another method of drag which has been used with some success is the rotation of a small fan in a liquid—a method perhaps rather better than the previous one, since resistance to rotation falls below the square of the speed, when the liquid itself begins to rotate. Much depends in this case on the shape of the receptacle containing the fluid.

A third method, certainly by far the best, consists in rotating a small inefficient dynamo, generally a mere disk, turning between permanent or electro-magnets. This resistance is of course directly proportional to the speed, and therefore to the torque, being indeed the machine reversed. By applying this drag, friction is again the only difficulty to contend with.

One other important point in connection with the drag and the friction we must not neglect. The greater the drag (commensurate, of course, with sufficient speed) the smaller the proportion of friction to the total load will be, and the greater the accuracy of the instrument's registration.

To sum up, then, it would seem that the most practical and useful meter, according to our present light, would be a motor meter of other than inductive type—preferably an energy rather than a current meter—with some force to balance friction, with a drag which is directly proportional to the speed, and which will be comparatively heavy, making the irregular friction as small a portion of the load as possible.

With all these features properly worked out and applied there can be no reason why a meter should not be accurate, efficient, comparatively cheap, and thoroughly able to take care of itself without undue attention.

There is another form of motor meter somewhat akin to the clock meters, which we discussed some little time ago. This comprises those instruments whose motor would rotate at a constant speed, provided the resistance to rotation were also constant. In other words, the current passing through the meter would be so arranged as not to cause fluctuations of speed in the motor directly. This is easily accomplished by placing the motor in shunt across the line like a lamp, and properly proportioning its windings. Variation in speed of the motor, which is geared directly to the dial, is accomplished in this class of meters by varying the resistance of rotation or drag.

This may be accomplished in several ways. One plan suggested provides for fans which could be more or less fully immersed in a fluid, the immersion of the fan being dependent upon the strength of the current, the fan, in fact, moving up and down the shaft in accordance with the influence of a kind of indicator mechanism. Thus, on very light loads, the fan would be immersed and would strongly retard the motor, while on very high loads, the fan would be almost removed from the fluid in which it rotated, and the motor would race in consequence.

This same end has also been accomplished by an electro-magnetic drag, somewhat similar to the damping device which has already been described, the electro-magnets being so arranged that their strength varied with the current in use on the line, and also at times with the potential on the line, and thus accomplishing the same purpose in a better way than the fluid fan just mentioned.

A. W. Childress and associates have obtained a franchise to construct and operate an electric street railway in Dallas, Tex. About fifteen miles of road will be built by July 1st.

Lord Salisbury opened the Liverpool overhead electric railway on February 4th. He first visited the generating station and started the engines, accompanied by the Earl of Lathom and Lord Kelvin, the mayor of Liverpool and the directors of the railroad. Lord Salisbury entered the train and passed along the line. The train ran smoothly at the rate of twenty-two miles an hour. Afterward, at the Liverpool town hall, the ex-premier delivered an address.

The "Ohm's Law" of the Magnetic Circuit.

Prof. D. C. Jackson, who is at the head of the electrical engineering department of the Wisconsin university, lectured recently before the Wisconsin Electric club, on "The 'Ohm's Law' of the Magnetic Circuit." He said that the development of the practical laws of the electric circuit were given an early advance through the investigation of scientists whose attention had been called to certain applications. Ohm's much quoted law was at once brought into a systematic and practical form, which covers in various modifications all conditions of the electric circuit. On the other hand the "magnetic circuit" was not carefully studied from a rational and practical standpoint until quite lately; but having been taken in hand by scientific engineers, it is now seen that the laws of the "magnetic circuit" have a striking similarity in form to the laws of electric flow. Beside the $C = \frac{E}{R}$ of the electric circuit may be written $N = \frac{M}{P}$ for the magnetic circuit. Each of these formulas, showing the relation between current (C and N), resistance (R and P) and pressure (E and M), expresses that which is a matter of observation in common affairs. Put in words the formulas may be expressed thus: Any result may be expected to be proportional to the effort put forth to attain it, divided by the resistance met and overcome. A familiar illustration of this general expression is the stretching of a wire, where the extension is equal to the applied pull divided by the elastic resistance of the wire. This fundamental law does not require for its comprehension any greater knowledge of algebra or applied mechanics than can be learned by intimate association with first-class steam engines and dynamos.

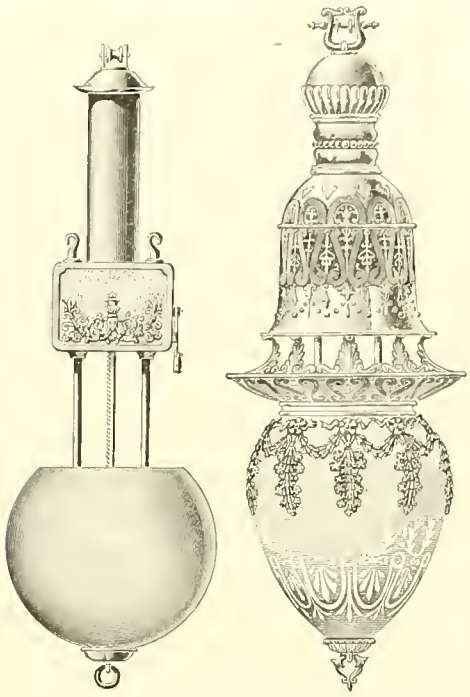
The analogy between the magnetic circuit and the electric circuit is very close. The conditions of the former are exactly represented by an electric circuit immersed in sea water, or other semi-conducting medium, as suggested by Faraday. At the same time there are fundameotal differences. Thus, there is no expenditure of energy required to maintain magnetic stream lines or lines of force, so that in the magnetic circuit there is nothing analogous to frictional loss in a mechanical contrivance, or the heating effect in the electric circuit. The electric resistance of a conductor is not changed by passing a current through it, unless it is overheated, while the magnetic resistance of magnetic metal varies in a very complex manner with the number of magnetic stream lines flowing through it. Electric conductors can be effectually insulated. The resistance of a piece of glass is no less than 700 billion times that of a similar piece of copper. The magnetic circuit can not be effectively insulated, for the magnetic resistance of a working circuit is not often less than 1-400 part of that of an equal body of air. This is more nearly comparable to the difference in resistance of what we call the good electric conductors, than the difference between electric conductors and electric insulators. Finally, from the similarity of the fundamental laws, we see that the laws of divided circuits will be the same in the electric and magnetic circuits, and we are enabled to make magnetic calculations with tolerable exactness where the magnetic quality of our iron is known.

New Incandescent Arc Lamp.

At the corner of Thirty-third street and First avenue, New York, is a large, substantial brick factory building, formerly utilized for the manufacture of gas fixtures and electroliers. This building is now owned and occupied by the General Incandescent Arc Light company, of which Sigmund Bergmann is president. Many styles of lamps are now being produced, from the plain outside lamp, shown in Fig. 1, to the elaborately ornamented and artistic affair, designed for interior use, Fig. 2. With machinery and tools of the latest improved design, every detail of the lamp is made in this factory. The lamp mechanism is exceedingly simple, consisting practically of only three wheels, a single magnet, and a spring, and it has no dash-pot. The German silver resistance wires, which are mounted on the outside of the lamps, are insulated with porcelain, making the resistance both fire and water proof. The standard 8 and 10 ampere lamps are arranged to run two in series on a constant circuit of 100 to 125 volts, but (up to 6 amperes at present) they can also be run three in series. The voltage may vary between 100 and 125 volts, it is claimed, without affecting the steadiness of the light. This feature of the lamp is a valuable one, and important in practice, not only as all currents are subject at one time or another, to fluctuations, but because it enables the consumer to vary the amount of light at will, by simply changing his pressure, and without changing the lamps. The company makes lamps taking current of from 3 to 25 amperes. The mechanism is exactly the same, the only difference being in the external resistance.

Another feature of these lamps is the construction of the lower carbon holder, which permits the changing of the carbons without taking down the globes. The lower carbon holder, as it screws into place, at the same time firmly clamps the carbon.

In the temporary show-room at the factory, there are a variety of lamps on exhibition—from the plain outside



FIGS. 1 AND 2. NEW INCANDESCENT ARC LAMP.

lamp, to the most elaborate theatre or church lamp. Hanging from the centre of the ceiling is a large lamp of the latter class, which is beautiful in its design and ornamentation. It has a large round globe, about which is a network of bronze filigree work, and its fittings are of the same metal artistically wrought.

The "Bijou" lamp is one of the latest designs of the company. It is a small lamp, intended for artistic interior lighting, with round globe, and is certainly very attractive. It has ribbon feed, instead of rack rod, and can be placed singly, or two or three in series, on a 110 volt circuit, or six in series on a 220 volt circuit. It gives from 150 candle power up, can be made to range from 3 to 8 amperes and to burn 8 to 10 hours. The standard lamps weigh 18 pounds complete (without globe), burn 12 hours, and with an 8 ampere current, give about 1,000 candle power, and with 10 amperes, about 1,300 candle power. The General Incandescent Arc Light company's offices are at 59 Duane street, at the corner of Elm. Its show-rooms are at 275 Fifth avenue, near Twenty-ninth street, and at its works, corner of Thirty-third street and First avenue.

Incandescent Lamp Litigation.

A Pittsburg dispatch dated February 1st says: "The Westinghouse company to day obtained an order in the United States Circuit Court directing the Edison General Electric company to show cause on Thursday of next week why the injunction which has been granted the Westinghouse company, restraining it from making the all-glass globe lamp, should not be so construed as to exclude the new stopper lamp of the Westinghouse company to be used for the World's Fair lighting, and thus prevent any further statement on the part of the Edison company that such new lamp is an infringement of the Edison lamp patent. This move was made because the Edison company has said it would contend that the new lamp was an infringement."

New Plant of the Electric Gas Lighting Company at Boston.

The Electric Gas Lighting company of Boston moved its manufacturing plant into new and more commodious quarters last month. The new factory occupies the second floor in the seven-story brick building of the Beebe estate on Dover street, Boston. A view of one corner of the shop is herewith presented. This floor contains about 6,000 square feet of space. Ten large windows give sufficient light for the front of the shop, before which and extending the entire width of the floor is the bench at which the finishing of the specialties which this company turns out is done. A forty foot double bench extending back from this is devoted to the finishing of switches of all kinds, Tyrolean bells, automatic keys, gas lighting cut-outs and annunciator work. The space in the center of floor is used as the department for bells. In the rear of this is located the machine shop, in which thirty machines are used, including upright and horizontal drills, engine and speed lathes, punches, screw and milling machines. Power is supplied from a main shaft running through the center of the shop having a 36 inch driving pulley for the heavy work and a 20 inch pulley for the lighter machines. The company does its own forging, all its tools, dies and punches being made and repaired on the premises. It also employs considerable wood working machinery for finishing bell boxes, bases and other work. The lockers containing all the special tools, dies, etc., used in the several departments are in the rear of this shop. Two very important departments are the buffing and plating rooms which have been specially fitted up for this particular work. The buffing room is fifteen feet square and the plating room is about twice as large.

NEW PLANT OF THE ELECTRIC GAS LIGHTING COMPANY AT BOSTON.

On the other side of the room is the assembling department for burners, which constantly keeps a dozen men busy. On this side a shelf five feet wide and over 100 feet long is suspended overhead where finished woodwork for annunciators and cut-out cases are stored ready to receive the mechanism. On the opposite side a similar shelf contains the finished work in stock ready for shipment. Also on this side is the stock room, where the many

electrical devices which this company manufactures are piled from floor to ceiling. The building also contains a large freight elevator, making shipping facilities first class. In short, the plan is an excellent one in every detail of the equipment and arrangement.

In 1880 this company was known as the National Electric Gas Lighting company, and an ex-mayor of Boston was president. In the following year Col. L. W. Burnham was elected to the presidency and immediately reorganized the company under its present title. Manufacturing was not begun until 1885, at which time it was carried on under difficulty, the shop consisting of an attic room of the New England Electric company. Since then the business has steadily developed under Col. Burnham, who has devoted his entire time to the general supervision, and, keeping in close touch with the detail of the business, has added not a little to the success of this company. There is probably no one better known to the electrical trade throughout the country than Col. Burnham, who by his honorable dealings has merited the confidence and friendship of the fraternity.

CORRESPONDENCE.

New York Notes.

NEW YORK, February 4.—Something of a sensation was produced in this city by the announcement of the introduction of a bill at Albany providing for the dissolution of the present Rapid Transit commission. Assemblyman Farquhar, who presented the measure, claims that it represents the views of prominent property owners in the metropolis, but the general opinion prevails that it is a scheme of Mayor Gilroy and other local politicians. It is proposed to appoint another commission to take up the subject of rapid transit. The present board has devoted two years to the study of the problem, and its solution, which was presented in the underground railway system advocated by the commissioners, has not met the approval of capitalists—at least they have not testified their belief in the practicability of the project by signifying a willingness to invest enough capital to build the road. There is a strong probability that the relief expected from the extension of the "L" road system will not be forthcoming without a protracted controversy, as the Manhattan company does not seem inclined to comply with the requirements specified by the commissioners. In fact, it has flatly refused to accept the provision touching the question of fare, claiming that it cannot afford to carry passengers sixteen miles for five cents.

A bill is pending in the legislature to permit cities or towns to construct, purchase or lease and maintain within their limits one or more plants for the manufacture or distribution of gas or electricity for municipal use and for the use of inhabitants. Where such plants are established payment may be made by the issue of bonds payable in 30 years, bearing interest not to exceed 5 per cent, and the indebtedness thus created is not to be included in the limit of the indebtedness of the city or town.

The New York Electric club is an institution of the past. The affairs of the organization are now being settled the old headquarters on East Twenty-second street, which were elaborately fitted up several years ago, have been closed and the furnishings and fittings have been disposed of at public auction. W. F.-O.

Milwaukee, Wis.

MILWAUKEE, February 4.—The many fires which have occurred in Milwaukee recently have caused the insurance men to institute a rigid inspection of the business blocks of the city. One of the most significant results of the examination is an order issued by the under writers requiring that the use of lamps in business blocks be abandoned and gas or electricity substituted. One of these orders a few days ago was directed to the owner of a building which is provided with gas and electricity. In one or two rooms, however, oil is used by the tenants for illuminating purposes, and the order from the underwriters directed that the practice be stopped at once.

Edward C. Wall, who has been mentioned by the daily papers all over the country in connection with a place in Cleveland's cabinet, is the president of the Badger Illuminating company of Milwaukee, and a vice-president of the Wisconsin Electric club. He is at the head of Villard's Milwaukee electric lighting business. When Mr. Cleveland was president before, Mr. Wall was the collector of internal revenue for the Milwaukee district. For more than two years he has been chairman of the Democratic state central committee, and he is also a member of the Democratic national committee from Wisconsin. Mr. Wall has been East for a week or more, and during that time he has had several interviews with the president-elect.

President Petley, of the Wauwatosa motor line, announces that the extension to North Greenfield will be built in the spring. It will be completed by July 1st. A bonus of something like $15,000 has been raised by property owners interested in securing the extension.

A marked novelty is the chimney on the Pabst power house, Broadway. Instead of being built of brick or iron, as such chimneys usually are, this one will be constructed entirely of steel, except the lining, which will be of fire brick. It looks like a huge smokestack, but differs very materially from the ordinary stack. The heavy steel plate shell is supported by a framework of structural steel, which, if the shell were removed, would show a skeleton just the shape of the chimney. The fire brick lining is also supported by the skeleton. Between the shell and the lining is an air space of a foot. The chief merit claimed for this chimney is great strength combined with lightness. It requires no heavy foundation, and will not settle and pull things out of shape. The chimney in question will be 225 feet high and provided with an ornamental top. Its outside diameter will be about 12 feet and the diameter of its smoke flue about 8 feet. The chimney will rise about 100 feet above the top of the building.

The street railway people furnish power for turning bridges, wherever the city desires it, without charge, and now Assistant City Engineer Schicke suggests that it would be a good plan for the city to have the bridges lighted with electricity, the power to be furnished by the street railway people. It is claimed that electric lights on the bridges would be a great convenience, and besides would render travel over the bridges much safer.

A heavy verdict was returned against the company in the case of Willie Hart, who sued the West Side Railway company for $15,000 damages for personal injuries. The jury found that the plaintiff, who is a mere boy, got on the car at the invitation of the motorman, and that he was not guilty of contributory negligence, as the company had claimed. The case attracted a great deal of attention.

The People's Institute is making arrangements for a course of lectures on electricity. Among the speakers will be Prof. Warren S. Johnson, Prof. A. J. Rogers and Prof. Chamberlain, as well as J. B. May. Other lecturers will be secured. The course will consist of ten lectures. The first one will be delivered by Prof. Johnson, whose subject will be "Electricity—What It Is and How Produced." Prof. Chamberlain will speak on "The Telegraph" and Mr. May on "The Telephone." The other lectures will include electric lighting, street car service, etc.

The South Milwaukee Town Site company has been incorporated by a number of wealthy residents of the city for the purpose of building up the new town of Carroll, a few miles south of Milwaukee. The capital stock of the company is $1,250,000. Its charter authorizes it to erect an electric lighting plant at Carroll and to build electric railways.

Advices from Racine state that a new telephone company will be organized at that place as soon as the Bell patents expire.

At Sheboygan the superintendent of construction of the Wisconsin Telephone company, who was arrested for putting up poles in the streets of the city, pleaded guilty to violating the ordinance requiring that a plan for the erection of electric lines must be submitted to the council. He was fined $10, the lowest penalty provided for. The company has suspended operations pending a decision on its application for a franchise.

The Oshkosh council is debating the question of burning the street lights, which are now put out at 1 A. M., until morning.

A South Side electric car was caught in the Oregon street railway gates the other day, but the motor was reversed and the car escaped being run down by a train.

Supt. Kleinsteuber, of the police alarm telegraph, has placed a whistle in the alarm box at the corner of Grand avenue and West Water street. The whistle can be heard a block, and the policemen at that point can be communicated with at any time from the police headquarters. The whistle is operated by compressed air, and the air is liberated by electrical apparatus.

The petition of citizens to have the tracks on Holton street, between Harrison street and North avenue, vacated by the council has been placed on file. Mr. Payne appeared before the committee and explained that the line formerly ran on Island avenue, where there is a steep hill, and for that reason the cars were run around by way of Third street. The people objecting to this, the Holton street franchise was secured, but the people had been told that the line could not be put in running order by January 1, 1893. Mr. Payne said that the work on the Holton street line would be commenced by spring. C

Denver, Colorado.

DENVER, February 4. — An electric light company with a capital stock of $100,000 has been organized in Boulder. It is the intention to put in a large Corliss engine and several dynamos, the latter to be used at first to furnish current for the extraction of mineral from ores by a new process, and second to furnish electric light. W. K. Mehollin is to be general manager. George R. Chavey is president, George A. Goddard vice-president, and Eugene Wilder secretary and treasurer. The city council has granted the new company the right to string wires through the streets and alleys.

The Lake City Electric Light company is to substitute steam for water power.

The conductors and motormen of the Pueblo City Railway company have formed a division of the Amalgamated Association of Street Railway Employes of America, with the following named officers: President, George R. Knapp; vice-president, G. W. Pringle; recording secretary, P. C. Lynch; financial secretary, E. E. Ellington; treasurer, Brook Eskridge; conductor O. S. Cunningham; warden, E. Smith; sentinel, Ira Rambo; trustees, George R. Knapp, F. Stevenson and J. C. Waddle. The organization has a membership of about 65.

The Denver, Lakewood & Golden Railroad company is now erecting poles for its electric line between Denver and Lakewood and between Denver and Barnum. Negotiations are pending between the company and the Lookout Mountain Resort company for the extension of the Lakewood line to the top of the mountain, the Lakewood officers having expressed a willingness to build.

The Durango city council refused a franchise to the Colorado Telephone company and is considering a petition from that company signed by seventy citizens to maintain its action in not granting a franchise. One of the objections against the franchise was that the Bell Telephone patent would soon expire, and that it might shut out cheaper systems.

E. S. Allen and Lyman Porter of Loveland are organizing a company for the establishment of an electric light plant in that city.

The Amethyst Electric Light & Power company has secured the exclusive franchise for lighting Creede for ten years.

A stock company with a capitalization of $50,000 has recently purchased the Longmont electric light plant. The new company will be known as the Longmont Electric Light & Power company, the members of which are all Loveland business men. D. C. Donovan is president, W. B. Wiswall, secretary and J. H. Jones, treasurer. The directors are: J. W. Turrell, F. H. Stickney, D. C. Donovan, J. H. Jones and W. B. Wiswall. The plant is in charge of C. M. McCamey of Denver. The company has contracted to furnish the city with ten new Thomson-Houston arc lamps of 2,000 candle power each and is to equip the Dickens Opera House with electric appliances.

The Montclair Electric Light company has made an assignment to Theodore Holland for the benefit of its creditors. The assets are placed at $19,280.82 and the liabilities foot up $151,312 62. At the same time the secretary of the company, W. F. Reed, assigned to D. B. Ellis for the benefit of his creditors. Shares in the electric company's stock, mining stocks etc., constitute his assets, which are placed at $149 629.80, and his liabilities at $135 934.75.

The Trinidad city council has granted the Mountain Electric company of Denver a twenty-year franchise. Work on the new plant will be begun within a month. The company also secured a five year contract for lighting the city E. C. D.

PERSONAL.

Stephen L. Coles of the *Electrical Review* was in Chicago on Monday.

J. W. Godfrey, general manager of the New York Insulated Wire company, is in Chicago.

Charles D. Jenney of the Jenney Electric Motor company of Indianapolis, Ind., was in Chicago last week.

Thomas Ferris, recently of the engineering department, General Electric company, Chicago, has been assigned to look after the company's interests in Iowa, with headquarters at Des Moines.

G. M. Angier, general agent for the Mather Electric company of Boston, left last week as a representative of that company on a trip to Mexico. The route taken to the city of Mexico is by the way of Chicago and St. Louis. He will visit a number of the prominent cities and places in Mexico, and then leave Vera Cruz for Cuba, and thence back to New York. Mr. Angier will be gone about 30 days.

J. Potter, who has been for many years treasurer of the Brush Electric company and president of the Short Electric Railway company, has resigned these offices, to

take effect at the convenience of the companies. Mr. Potter graduated from Princeton College in 1877. For several years he was master in the Lawrenceville school, during which time he read law. In 1881 he decided to engage in the electrical business and made an engagement with the Brush Electric company to take charge of its business in China and Japan, and was the pioneer of electric lighting in those fields. He resided for a number of years in Yokohama and made large contracts with the Chinese and Japanese governments, and established the first electric lighting stations in the Orient. In 1884 he returned to Cleveland to take the position of treasurer of the Brush company. It is understood that Mr. Potter will devote himself entirely to his private business interests. He is one of the promoters of the projected Lake street and crosstown railway of Cleveland. He is also interested in a number of electric lighting and street railway enterprises to which he will give his attention.

NEW INCORPORATIONS.

The Lewistown Electric Light & Power company, Lewistown, Mont.; capital stock, $10,000; to light the town of Lewistown, Fergus county, Mont., by electricity.

Auburn Electric Motor company, Auburn, Maine; capital stock, $50,000; to manufacture and deal in electrical apparatus of all kinds; Tascus Atwood, Auburn, Maine.

Electric Supply company, Port Huron, Mich.; capital stock, $5,000; to manufacture and sell electrical and other goods and merchandise; L. A. Sherman, Port Huron, Mich.

Phillips Electric Light & Power company, Phillips, Me.; capital stock, $10,000; to establish and maintain an electric light plant at Phillips, Maine; Harry E. Beedy, Phillips, Maine.

Electric Dice Game company, Chicago, Ill.; capital stock, $500,000; to manufacture and deal in electrical and mechanical devices, etc.; E. D. DuBois, 95 Clark street, Chicago, Ill.

Portelectric company, Saco, Me.; capital stock, $7,000,000; to own, operate and deal in apparatus for propelling and transmitting matter by electrical means; Fairfield & Moore, Saco, Me.

Superior Machine company, Cleveland, O.; capital stock $25,000; manufacturing and selling gear cutting machinery, dies, stamps, tools, electrical appliances, etc.; Carpenter & Young, Cleveland, O.

Philadelphia and Delaware Street Railway company, Chester, Pa.; capital stock, $150,000; constructing and operating an electric railway in Delaware county; Ward R. Bliss, Chester, Pa.

Harrison International Telephone company, Chicago, Ill.; capital stock, $80,000,000; to manufacture and deal in telephone, telegraph and electric service; C. M. Ferree & Co., Kansas City, Mo.

Eliot Falls Electric Light company, Portland, Me.; capital stock, $100,000; to carry on the business of an electric lighting, manufacturing and power company; Clarence Hale, Portland, Me.

Bound Brook Electric Light, Heat & Power company, Bound Brook, N. J.; capital stock, $5,000; generating and furnishing electricity for light, heat and power; Chas. P. Sebring, North Plainfield, N. J.

Swaney Electric company, East Liverpool, O.; capital stock, $10,000; furnishing electric light, heat and power, manufacturing and dealing in electrical appliances, etc.; H. B. Hill, East Liverpool, O.

Montgomery County Passenger Railway company, Norristown, Pa.; capital stock, $50,000; constructing and operating an electric railway in Montgomery county, Pa.; Daniel A. Holland, Conshohocken, Pa.

Philadelphia West Side Passenger Railway company, Philadelphia, Pa.; capital stock, $250,000; constructing and operating an electric railway in Philadelphia; John C. Bell, 333 Walnut street, Philadelphia, Pa.

Florence Rapid Transit & Power company, Florence, Col.; capital stock, $100,000; to build and equipan electric railroad from Florence to Williamsburg, Rockvale and Coal Creek towns in the vicinity of Florence.

Enamel Electric Manufacturing company, East Orange, N. J.; capital stock, $10,000; to manufacture, use and deal in all kinds of electrical machinery, etc.; Walter & Crittenden, 206 Broadway, New York, N. Y.

Forty-second Street & West Park Passenger Railway company, Philadelphia, Pa.; capital stock, $250,000; constructing and operating an electric railway in Philadelphia; John C. Bell, 333 Walnut street, Philadelphia, Pa.

Central & Consolidated Electric company, 68 Broad street Elizabeth, N. J.; capital stock $200,000; to manufacture and sell electrical goods, tools, machinery and appliances, etc.; R. V. Lindsbury, Elizabeth, N. J.

Calumet Electric Manufacturing & Engineering company, Chicago, Ill.; capital stock $10,000; to manufacture and deal in general electric machinery and work; Ashcraft & Gordon, First National Book Building, Chicago, Ill.

Automatic Telephone & Electric company of Illinois, Chicago, Ill.; capital stock, $250,000; to construct and operate telephone, signal and electric systems, manufacture apparatus for use of same, etc.; J. R. Griffitts, Chicago, Ill.

Mineral Springs Mining & Improvement company, Navasota, Tex., capital stock, $150,000; manufacturing and mining in the counties of Grimes, Brazos, Madison and Leon, Texas, establishment and maintenance of hotels; supply water to the public; manufacture and supply of gas and the supply of light, heat and electric motor power; James H. Freeman, Navasota, Tex.

Forty-ninth Street & Westminster Avenue Passenger Railway company, Philadelphia, Pa.; capital stock, $250,000; constructing and operating an electric railway in Philadelphia; John C. Bell, 333 Walnut street, Philadelphia, Pa.

Commonwealth Electric company, Camden N. J.; capital stock, $100,000; to manufacture and construct dynamos, motors, lamps, machinery, apparatus and appliances of every kind and character, etc.; Jas. E. Hayes, Camden, N. J.

District Love Electric Traction company, Harper's Ferry, W. Va.; capital stock, $250,000; constructing, laying, using and operating the Love Electric Traction system; E. S. Nyman, 1324 F street N. W., Washington, D. C.

Lawrence Gas Fixture Manufacturing company, Philadelphia, Pa; capital stock, $10,000; to manufacture and sell gas pipe, gas, electric or combination fixtures, machinery; Walter Penn Shipley, 404 Girard avenue, Philadelphia, Pa.

Stillaguamish Land company, Everett, Wash.; capital stock, $50,000; to deal in lands, buildings, etc., build, own, equip and manage railroads, gas works, electric light and power plants, and telegraph and telephone lines; Brown & Brownell, Everett, Wash.

Oliphant Suburban Traction company, Oliphant, Pa.; capital stock $36,000; constructing and operating an electric railway from Dunmore to Oliphant, to Winton to Archbald, all in Lackawanna county, Pa.; O. B. Partridge, 421 Lackawanna avenue, Scranton, Pa.

Richter Electric company, Camden, N. J.; capital stock $100,000; to manufacture dynamos, motors, arc and incandescent lamps, machinery, apparatus and appliances of every kind, character and description to which electricity is applicable, etc.; James E. Hays, Camden, N. J.

LEGAL DECISIONS.

Where the charter of a city provides that the Common Council shall have the power to authorize the use of the streets for horse and steam railroads, the words "horse and steam railroads" are not words of limitation and the council is empowered to grant such franchises to electric railways. Buckner v. Hart, U. S. Circuit Court of Louisiana. 53 Fed. Rep., 835.

In the case of the United Lines Telegraph company and Edward S. Stokes, appellants, v. the Boston Safe Deposit & Trust company, on appeal from the United States Circuit Court for the southern district of New York, the Supreme Court has, in an opinion rendered by Justice Blatchford, affirmed the decree of the lower court in favor of the Rapid company. The dispute concerned the ownership of a line of telegraph between Cleveland and Chicago, one party claiming under a Rapid mortgage of $3,000,000, and the other under a mortgage from the Bankers and Merchants' company amounting to $10,000,000. Justices Brewer and Field dissented.

In an action against an electric street railway company for injury to a passenger from a plank on the track, the questions of fact involved being whether the company placed the planks there, whether it inspected its tracks with reasonable frequency, whether the motor man kept a sufficient lookout, and whether the brake was deficient, and it appearing that the company was in the habit of carrying on open cars more passengers than could be accommodated with seats, and that a speed of 15 to 20 miles an hour was not considered unreasonable by it, and that it was customary to let the car run down grade by gravity, leaving it dependent for stoppage on the brake, an instruction can not be complained of for requiring of the company and its employes extraordinary care and diligence. Cogswell v. West Street & N. E. Ry. company, Supreme Court of Washington, 31 Pac. Rep., 411.

A dispatch was left at a telegraph office to be forwarded to another city. The dispatch was: "Strauss gone to Howard. Gave man gold watch by mistake. Left no word with me. Store closed. Answer." Strauss was a clerk, whom the man sending the message had left in charge of his jewelry store in his absence, and during the night or early in the morning before the dispatch was sent, had robbed the store, and absconded with the property, and the dispatch was in relation to the absconding, but the telegraph company's agent had no notice thereof. The dispatch was not transmitted for an hour and a half, and then it remained in the office to which it was forwarded for two hours before it was delivered or any effort made to deliver it. The court held that the jeweler could not recover more than the cost of the message and incidental expenses. Western Union Telegraph company v. Cornwall, Court of Appeals of Cal., 31 Pac. Rep., 394.

A dispatch from Philadelphia announces an important decision by Judge McCollum of the Supreme Court of Pennsylvania in the case of Winter against the Federal street & Pleasant Valley Passenger Railway company of Pittsburgh. The defendant corporation is an electric railway company operating by means of the trolley system. The plaintiff was the owner of a truck and two horses. He was employed in putting a safe into a building and his horses stood in a position to impede the progress of the cars. Several times he moved his horses in order to let the electric cars pass, but finally refused to move, contending that he had a right to the thoroughfare for a length of time sufficient to finish his work. One of the cars came along and, running into his horses, inflicted such injuries that he was compelled to kill them. Suit was begun in the Common Pleas Court of Allegheny county and a verdict secured for damages just sufficient to cover his loss. The defendant company applied for a new trial but was overruled by the judge. The Supreme Court has reversed this decision. If the cause given had been contributory negligence there would be no cause for general complaint, but in his opinion, Justice McCollum in order to strengthen the contributory negligence reason, said: "In these days of rapid transit, by means of the cable and trolley systems of car propulsion, property-holders along the line of the route and citizens generally must be given to understand that there must be an abridgment of their uses of the street. To use them now as in the days of car horses would be impracticable." This means that any railway corporation securing cable or trolley privileges has practically the use of the street to the exclusion of other vehicles. If this decision stands, in some of the more narrow streets which are likely to be used by the trolley companies for short cuts it will be impossible to get in coal or use furniture cars for removal purposes. The opinion is a long one and is devoted to emphasizing the rights of the cable and trolley rapid-transit companies to the use of thoroughfares.

ELECTRIC LIGHTING.

A proposition to light the town of Lewiston, Ill., by electricity is being considered.

Negotiations have been completed by the town of Mondova, Wis., for an electric light plant.

The People's Electric Light & Power company of Savannah, Ga., will put in a plant to cost $200,000.

The annual report of the directors of the Edison Electric Illuminating company of New York, undoubtedly the largest central station company in the country for incandescent lighting, shows that at the close of 1892 the company had 142,492 lamps connected, and 4,344 customers. Arc lamps to the number of 1,637 are operated, and also motors aggregating 3,807 horse power. Estimating each horse power motor and each arc light as equal to ten 16 candle power lamps, the present installation is equal to 196,932 lamps. The gross earnings were $942,575 23, and the net earnings $475,137.61. The latter increased 36 per cent. over 1891.

ELECTRIC RAILWAYS.

Owing to the difficulties the Duquesne Traction company has encountered with the Wilkinsburg, Pa., authorities, the company has announced its intention to abandon the idea of running the cars on the line into the town, since so many complications have arisen, and will run its cars through Brushton as far as the Wilkinsburg line, at which point they will turn.

The Calumet Electric Railway company of Chicago has given a mortgage to the Jennings Trust company for $1,250,000, of which $1,000,000 is included in construction bonds and $250,000 in the improvement bonds. The loan is made in 6 per cent. gold bonds of $1,000 each, payable in New York or Chicago, subject to call within ten years at 10 per cent. premium and after ten years, at 5 per cent. premium, 10 per cent. to be called annually after September 1, 1903.

TRADE NEWS.

General Manager E. R. Rand of the Newton Rubber company of Boston was in New York last week. Mr. Rand reports a good business in rubber materials for electrical purposes.

An interesting little pamphlet explaining the Carpenter heater has just been sent out by Charles D. Shain, general selling agent for the Carpenter Enamel Rheostat company of Bridgeport, Conn.

The Rockford Electric Manufacturing company has lately installed two interesting organ blowing plants in Rockford. It is said that these installations are based on a different method of regulation than has heretofore been used.

George Cutter, Chicago, has just closed a contract for fourteen miles of 550,000 circular mil simplex weatherproof cable for the Chicago City Railway company, which will be made with 76 strands, over 1,000 miles of No. 12 copper wire being needed for the core.

The Buckeye Electric company announces that there is a great demand for its lamps and that during the last week it has shipped an unusually large number to Western points. The company is prepared to ship direct from its Chicago stock to all Western consumers.

The Yale & Towne Manufacturing company has just secured an order through W. L. Dearborn for a 20 ton 3-motor electric traveler, 58 feet 4 inch span, for the new Chicago Edison company's station. This crane will be used for handling the armatures, pumps and heavy machinery.

Queen & Co., Philadelphia, report a steady demand for their portable photometers. It is very important from an economical standpoint, for a central station manager to use lamps that give the greatest illumination for energy consumed, and this convenient apparatus enables comparisons of different types to be quickly made.

The Logansport Electric Light & Power company has started the new 150 horse power Ball engine made by the Ball Engine company, Erie, Pa., and the new 1,300 light compound wound alternator, made by the Fort Wayne Electric company, Fort Wayne, Ind. The engine and alternator made a run on the first night of sixteen hours with perfect satisfaction in every particular. The new dynamo is the first of the latest improved machines made by the Fort Wayne Electric company. D. M. Seymour of the Ball Engine company, and Messrs. J. J. Muir and Whitney

steam expert and electrician of the Fort Wayne Electric company, were present when the engine was indicated. Several cards were taken under various loads, which were very satisfactory.

F. A. Wunder of the Fort Wayne Electric company has just closed a contract with W. T. Anderson of St. Louis for a 40 light Wood arc dynamo for Columbia, Mo. This machine is to be used to supply current for lamps furnished under a contract with the city of Columbia. This sale is but one of a goodly number that have been made by Mr. Wunder since his connection with the Fort Wayne company.

"Micanite, and its application to armature insulation," a paper recently read before the American Institute of Electrical Engineers, has been reprinted by Eugene Munsell & Co. of New York, for distribution among their customers, together with a price list for the trade. In this publication the properties of micanite, its application to armature insulation and the advantages arising from its use are presented and discussed.

The Wirt dynamo brush, it is claimed, will remedy the disastrous tendency to spark and cut at the commutator. Many of them are in use in central stations and isolated plants and good results are obtained. There is nothing that an engineer admires more than a quiet, smooth running commutator. It means to him a relief from one of the most serious and annoying defects or evils of the dynamo room. The Electrical Supply company, corner Michigan avenue and Randolph street, Chicago, is manufacturing these brushes in all sizes to fit any brush holder.

W. P. F. electric battery compound is the name of a new article which has found its way upon the market in the form of a "dry product." The solution can be made as dense as desired, according to the construction and requirement of the battery. It is claimed that the full current is retained until the power of the solution is completely exhausted. The compound, it is stated, dissolves readily and completely in water. There is no formation of crystals through the chemical action on the zinc or carbon, thus avoiding increase of internal resistance. This compound is manufactured by the Electro-Chemical & Specialty company, at 136 Liberty street, New York.

BUSINESS.

The Commonwealth Electric company, Philadelphia, announces that it has removed to No. 413 Market street, where, with increased facilities; it will be in a position to fill orders on the shortest possible notice.

The Sawtell company of Boston on February 1st removed from 243 Franklin street to the Shawmut building, at 146 Franklin street, where it has larger facilities for carrying on its business as New England agent for the renewal of burned-out lamps, and also for the Springfield Motor & Switch company. This company is now also prepared to do wiring and light construction.

Although the interest of the general public in lead pencils may not extend beyond the coveted possession of a goodly supply, the Joseph Dixon Crucible company is trying to excite it somewhat by distributing an exceedingly handsome and complete catalogue of lead pencils. It is claimed that Dixon's American graphite pencils are the only ones which can claim to be American products in every particular.

The Rockford Electric Manufacturing company has just installed another iron clad motor of 25 horse power capacity in the *Inter Ocean* office, Chicago, to run the new Scott perfecting press. This makes eight motors of this make that the *Inter Ocean* company has installed. The company has also made arrangements to place one of the same size in the World's Fair for Walter Scott & Co. to run one of their presses in machinery hall.

The Central Electric company, Chicago, received an order last week by telegraph for thirty miles of No. 4 weatherproof wire, the conditions of the acceptance of the order being that it would be shipped on the same day. The order was filled out of the company's own stock. The Central Electric company can be congratulated on being able to handle business of this magnitude in so prompt a manner. The company hopes to have its new catalogue finished by April 1st, and begs the indulgence of its patrons, assuring them that they will be well repaid.

Frank R. Chinnock of New York, eastern agent of the Ball Engine company of Erie, Pa., reports large sales throughout his territory. The following named equipments are among the recent orders he has filled: Buffalo North Main & Tonawanda Street Railway company, Tonawanda, N. Y.; Ithaca Street Railway company, Ithaca, N.Y.; Seabury & Johnson, East Orange, N. J.; Hahne & Co., Newark, N. J.; Dows Stores, Brooklyn, N. Y. The Ball Engine company recently issued a handsome descriptive catalogue on automatic high speed engines for electrical purposes.

An invention for providing means by which one telephone in a building may be used by persons in the different rooms or offices has been patented by William N. Marcus, of Philadelphia. The object of the invention is that one telephone may be made to communicate with several rooms in the same building, so that communications may be received in, and sent from, a room in which no telephone is located. Speaking tubes are placed throughout a building, running from a central office. A circuit wire is placed in connection with each tube, and in the guest room, if in a hotel or office, is a telephone receiver, which, when not in use, hangs from a peg. If this apparatus is used in a hotel and a call comes to the office telephone for a guest, the clerk calls through the speaking tube to the guest's room that some one desires to speak to him over the telephone. The guest has only to take the receiver from the peg in his room and carry on a conversation the same as if he were directly at the telephone, proper connection having been previously made in the office. A guest may also send a telephone call by requesting, through the speaking tube to the office, to be connected, and when the connection has been made carry on a conversation as already described. In large office buildings, as well as in hotels, this invention can be used advantageously, and where employed one telephone can be used by all the offices, thus avoiding the necessity for every office having a separate telephone. Mr. Marcus has also patented auxiliary mouth-pieces for telephones, and supports for telephone receivers.

A unique invention in connection with display electrical advertising in street cars operated by electricity has been made by H. T. Richards of New York. In the space usually devoted to advertising in street cars, where heretofore cardboard signs have been hung, this new electrical invention is to be operated. Mounted along this space, on both sides of the car, will be placed, in neat frames, glass of any shade ground on one side and cut in the usual size of the street car advertising panel. Concealed behind this glass will be placed one or more incandescent electric lamps. Behind these lamps, in some cases, will be placed reflectors of suitable material. The advertising copy to be used with this invention will consist of sheet iron, tin, card-board or any opaque substance. The type, trademarks or designs will be cut out of the sheet iron, tin or cardboard, permitting the rays of the electric lamps to shine through. If the advertiser chooses to use copy similar to that at present used in street cars, composed of colored letters, etc., he can do so. These panels or advertisements will be placed behind and against the ground glass in the frames, and will not take up any more room in the car than the present cardboard signs. The electrical device which operates these advertisements is not complicated; in fact, it is quite simple. The current used in driving the car lights the lamps, and a clock placed in the car will serve the double function of telling the time of day, as well as furnishing the means of periodically illuminating the panels. The circuit connections are so arranged that an automatic circuit closer, controlled by a clock, will cut into and out of action successively the lamp or lamps behind the several panels, so that only one advertisement, whether it is embodied in a single panel or in two or more panels, will be displayed at one time. The matter of cost in equipping the cars with this invention is not great. This invention can be applied to electrical advertising in frames or panels in various sizes, on the tops of buildings or other structures, in shop windows, hotels or theaters.

ELECTRICAL PATENTS.

Issued January 31, 1893.

490,641. Insulating Compound. Mathew H. Devey, Chester, Pa.

The compound consists of eight parts of slag and two parts of glass ground fine, and mixed with sufficient quantities of boiled linseed oil, driers, shellac and paraffine to reduce the ingredients to a paste; the paste being caused to set quickly by the addition of Portland or other cement.

490,659. Process of Treating Ores. William B. Jackson, Pueblo, Colo.

490,663. Electric Block Signal System. John La Burt, New York.

The signal system is automatically operated by the movements of the train to display signals in advance of and to the rear of every train, means being also provided for shutting off the steam of a locomotive in case the engineer, through accident or mistake, runs over the signal.

490,678. Apparatus for Electrically Treating the Eyes. William A. Price, Iowa Falls, Ia.

490,679. Apparatus for Electrically Treating the Ear. William A. Price, Iowa Falls, Ia.

490,684. Automatic Alarm Device. George W. Schilling and John G. Haslam, Philadelphia, Pa.

490,690. Railway Yoke. Morris S. Towson, Cleveland, Ohio.

490,698. Electrical Time Indicating Apparatus. Edward Weston, Newark, N. J.

The indicating apparatus comprises means for regulating clocks at a distance by means of electricity without the intervention of contact points in the electric circuit. A loop conductor is adapted to be moved in a field of force, and is connected in circuit with a second loop conductor, also movable in a field of force, which second conductor controls the movement of the indicating mechanism by its movement. The first conductor may be an alternating dynamo provided with a pair of pole pieces and a single coil so that as the coil revolves two pulsations of current will be sent through the second coil, which is located at the clock, causing it for each pulsation to oscillate, thus acting as an escapement, and permitting the clock train to move the hands over the dial.

490,699. Recording Ammeter. Edward Weston, Newark, N. J.

A body of conducting material of known resistance per unit length is connected in direct circuit with the current to be measured, and in a shunt circuit is included an arm moving in contact with the body of conducting material together with a motor mechanism which, when actuated, is adapted to move the arm. The construction is such that upon a change in current strength on the direct circuit the corresponding change in electrical pressure on the shunt circuit will cause the motor mechanism to act to move the arm along the body of conducting material to a position where the former difference of potential on the shunt circuit is re-established.

490,700. Electrical Measuring Instrument. Edward Weston, Newark, N. J.

A fine wire is expanded by the heating effect of the current to be measured, the extent of the expansion being indicated upon a suitable scale by means of a pointer. A support is provided for the expansible wire having the same coefficient of expansion as the expansible body, so that any variation in dimension of the expansible wire caused by extraneous influences, such as changes in atmospheric temperature, will be compensated for by the like change in dimension of the support due to the same cause.

490,725. Electrical Pressure Indicator for Steam Gauges. Edward G. Smith, San Jose, Cal.

490,744. Electric Time System. William F. Gardner, Washington, D. C.

490,746. Electric Switch. Jacob S. Gibbs, Hartford, Conn.

490,753. Secondary Battery Electrode. Harry G. Osburn, Chicago, Ill.

490,755. Connector for Electrical Conductors. George L. Russell, Middletown, Conn.

490,760. Electrical Measuring Instrument. Edward Weston, Newark, N. J.

490,761. Electric Signaling System. Adoniram J. Wilson, Port Chester, N. Y., and Wilmer W. Salmon, Chicago, Ill.

490,762. Electric Circuit Breaker. Edward M. Bentley, Boston, Mass.

The circuit breaker is adapted to extinguish the arc caused by the breaking of an electric circuit, and may be applied to switches, contact arms, etc. A switch lever is arranged to travel over a series of fixed contacts insulated from one another, and provided with an air pump of small capacity, the piston of which makes a forward stroke automatically upon each change of position of the lever, thereby compressing the air within the cylinder, which is permitted to escape through a valve which is opened at the instant that the lever breaks contact with the contact point.

490,809. Dynamo Electric Machine. Robert Lundell, Brooklyn.

The dynamo is provided with a disk armature and a single field magnet coil lying in a plane on one side of the armature and parallel to it.

490,810. Dynamo Electric Machine or Electric Motor. Robert Lundell, Brooklyn.

The dynamo is provided with a disk armature and a pair of field magnet coils, one lying on each side of the armature and in planes parallel to the plane of the armature.

490,839. Thermal Circuit Closer. Elihu Thomson, Swampscott, Mass.

490,841. Process of Electroplating Aluminum. Georg Wegner, Berlin, Germany.

490,869. Burglar Proof Safe. Warren H. Carr, Bath, Me.

490,870. Electric Burglar Alarm. Warren H. Carr, Bath, Me.

490,882. Telethermometer. Howard B. Payne, Chicago, Ill.

490,883. Telethermometer. Howard B. Payne, Chicago, Ill.

490,891. Electric Warming Bottle. Thomas Ahearn, Ottawa, Canada.

490,903. Combined Gas and Electric Light Fixture. Francis X. Gartland, Philadelphia, Pa.

490,917. Switch and Safety Fuse. Elmer P. Morris, Boston, Mass.

490,926. Thermostat. John R. Roberts, Homer City, Pa.

490,953. Art of Generating Electricity. Thomas A. Edison, Menlo Park, N. J.

The art consists in causing the dry decomposition of a chemical compound in a rarefied atmosphere, and in the presence of a positive element which is attacked by such compound, and electrically charged thereby, and a negative element which is electrically charged by the dry chemical reaction. Oxide of iron may be used as the chemical compound, and its decomposition effected by the application of heat, the rarefaction being maintained by an air pump. When oxide of iron is used carbon may be used as the positive element.

490,954. Manufacture of Carbon Filaments for Electric Lamps. Thomas A. Edison, Llewellyn Park, N. J.

The method of manufacture consists in forming filaments of carbonizable material, maintaining them in the desired shape, and partially carbonizing them before they have been soaked, or otherwise similarly treated, then filling the pores of the filaments by soaking them in liquid carbonizing material, and finally completely carbonizing the filaments.

490,959. Coupling of Dynamo Electric Machines in Parallel. Albert Gay, London, Eng.

490,975. Electric Railway. Edward W. Mitchell, Covington, Ky.

The feed wire extends within an insulating covering, having openings at intervals, and a sectional service conductor extends along the feed wire, and is composed of rigidly connected insulated sections, each insulated section being provided with a plurality of contacts adapted to establish connection with the feed wire. Means are provided for yieldingly holding the contacts normally out of contact with the feed wire.

490,992. Electric Arc Lamp. James Sugden and Wallace J. L. Sandy, London, Eng.

The lower carbon is supported upon the core of a solenoid which is included in series with the carbons, and when actuated draws the carbon down against the tension of a coiled spring. The upper carbon depends from a piston working in a closed air tube and under the influence of the air acting upon the piston has a tendency to descend but is normally prevented from descending by means of a brake wheel held against the carbon rod by the armature of an electro-magnet in series with the carbons. Upon sending current through the lamp the carbon points being in contact, the lower carbon is moved downward against the tension of the spring by the excitation of the lower solenoid, and the electro-magnet is at the same time excited to lock the upper carbon in position, thus establishing the arc. When the arc becomes abnormally long the electro-magnet is weakened, and the brake is released, thus permitting the air pressed piston to feed the upper carbon.

491,004. Electric Stop Motion for Knitting Machines. Winslow M. Bell, Milton, N. Y.

491,014. Trolley Wheel. John J. Goetz, Covington, and John A. Smith, Dayton, Ky.

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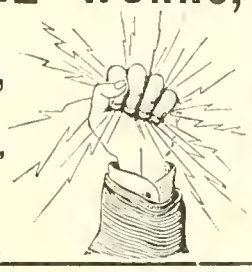

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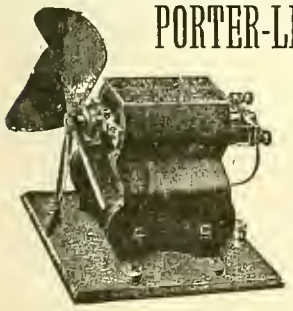

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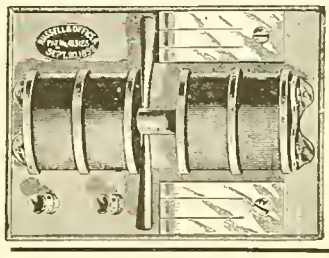

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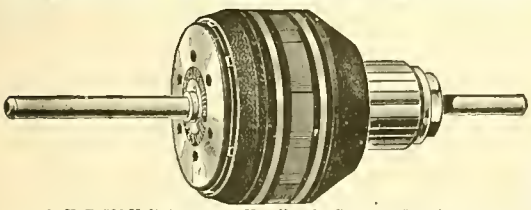

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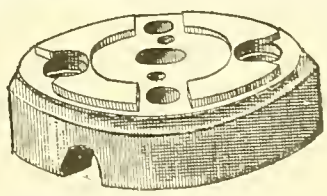

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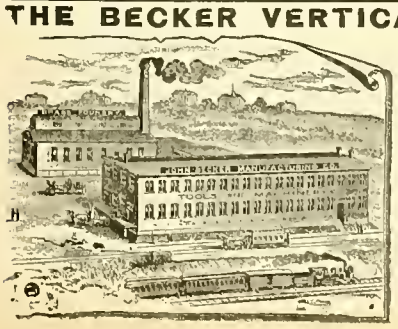

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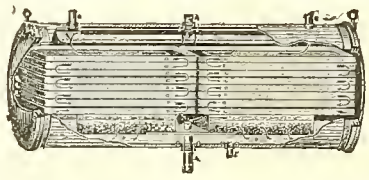

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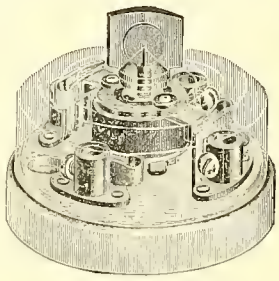

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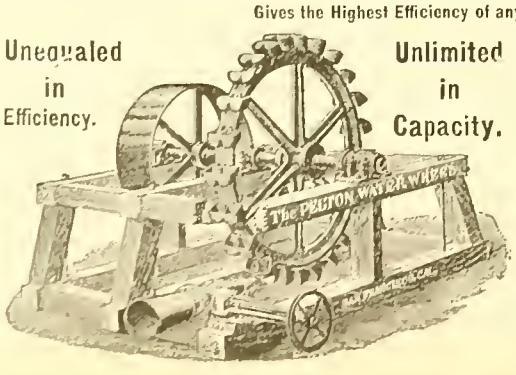

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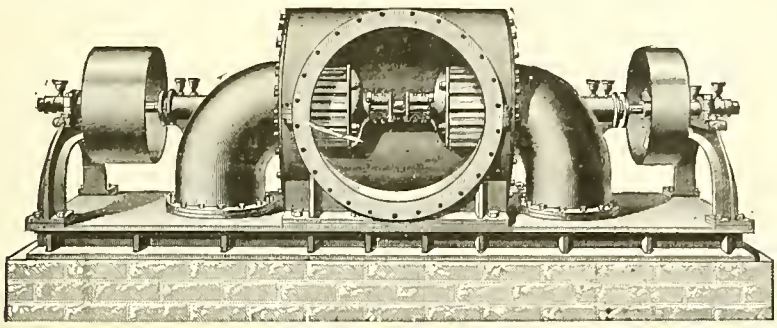

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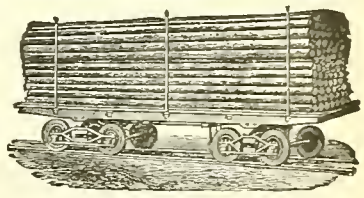

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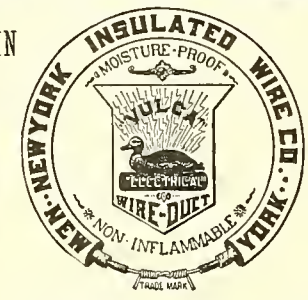

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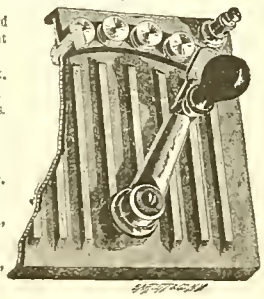

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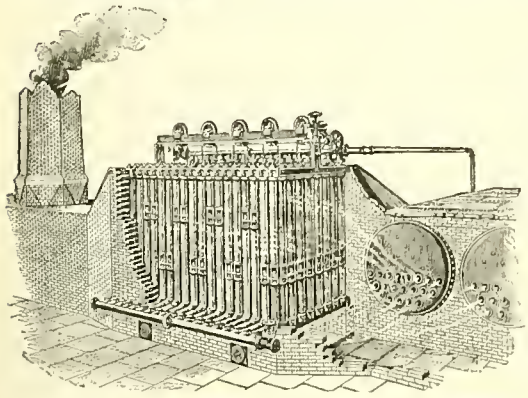

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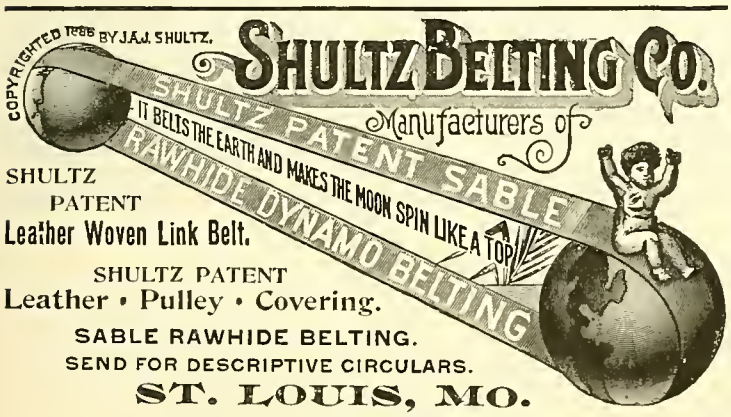

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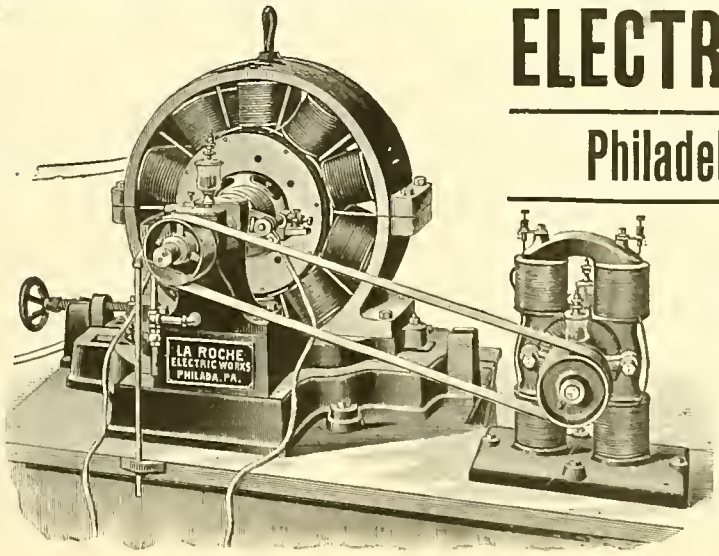

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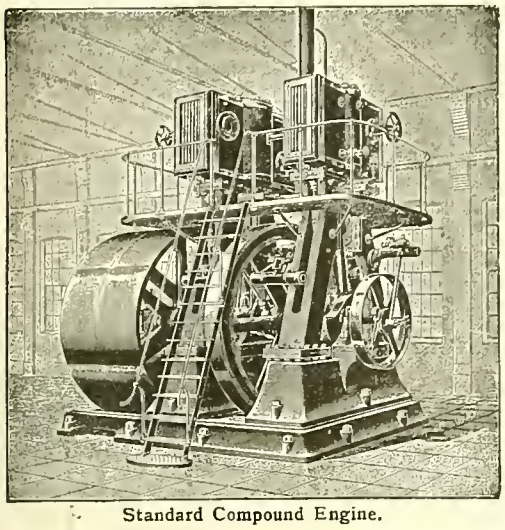

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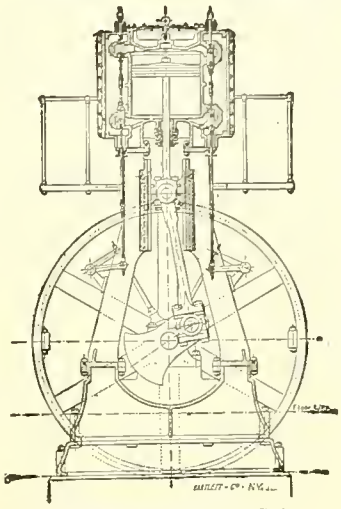

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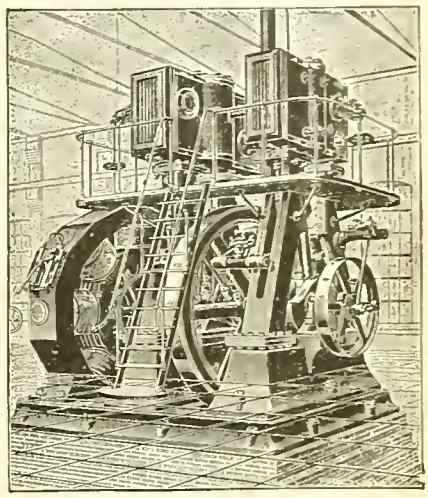

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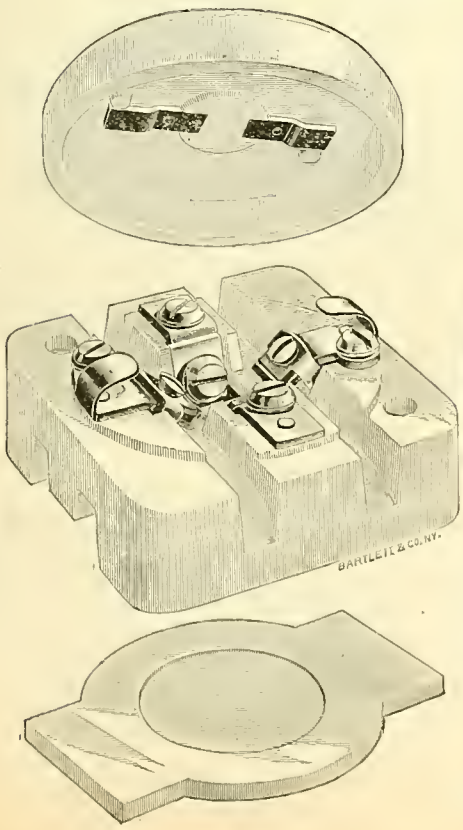

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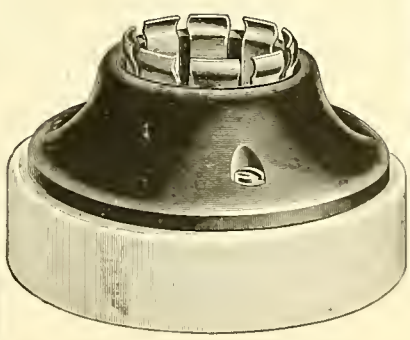

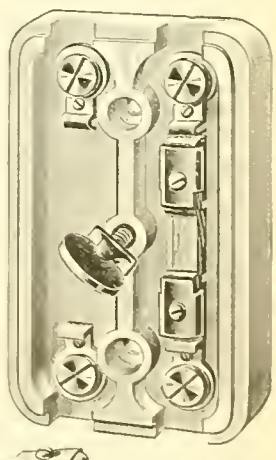

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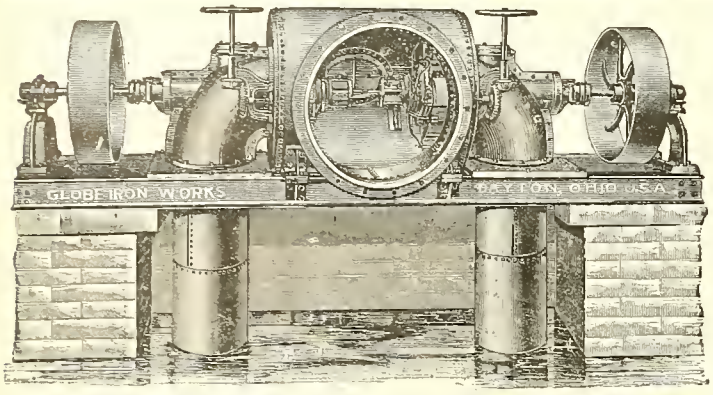

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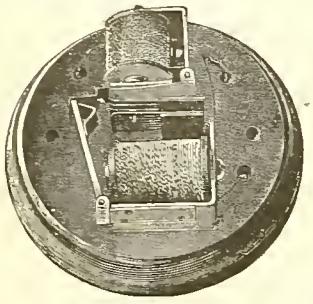

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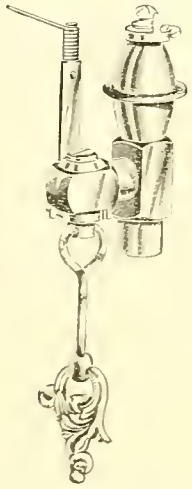

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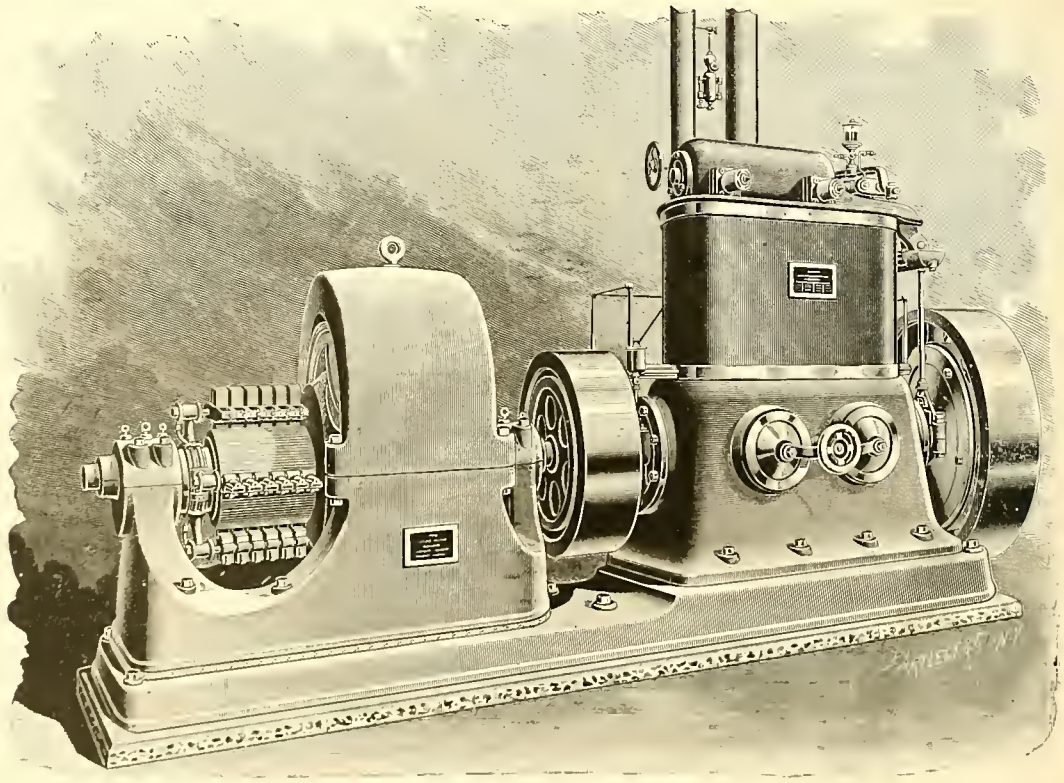

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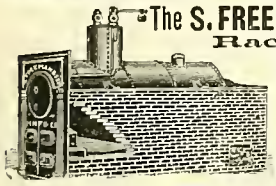

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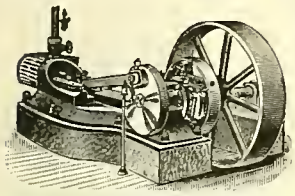

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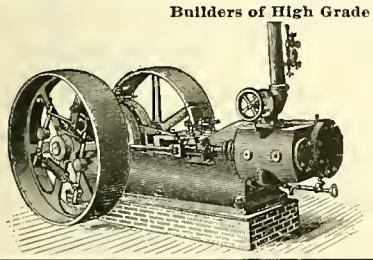

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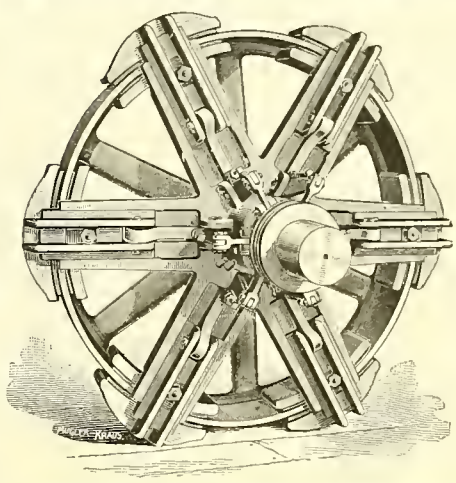

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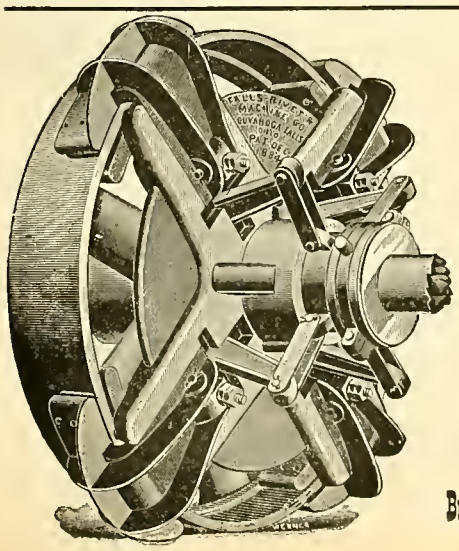

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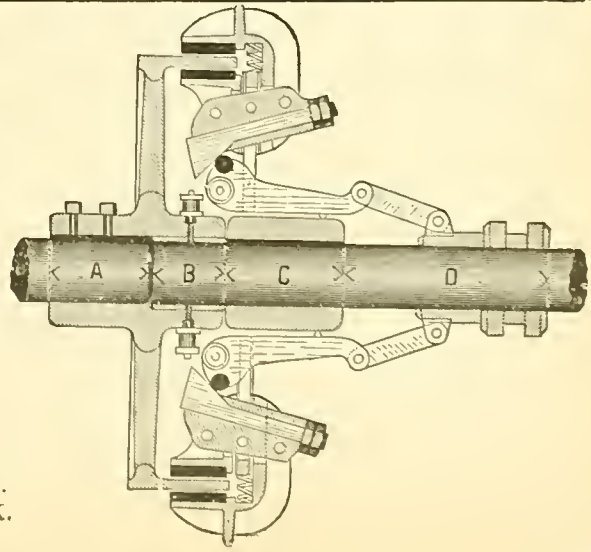

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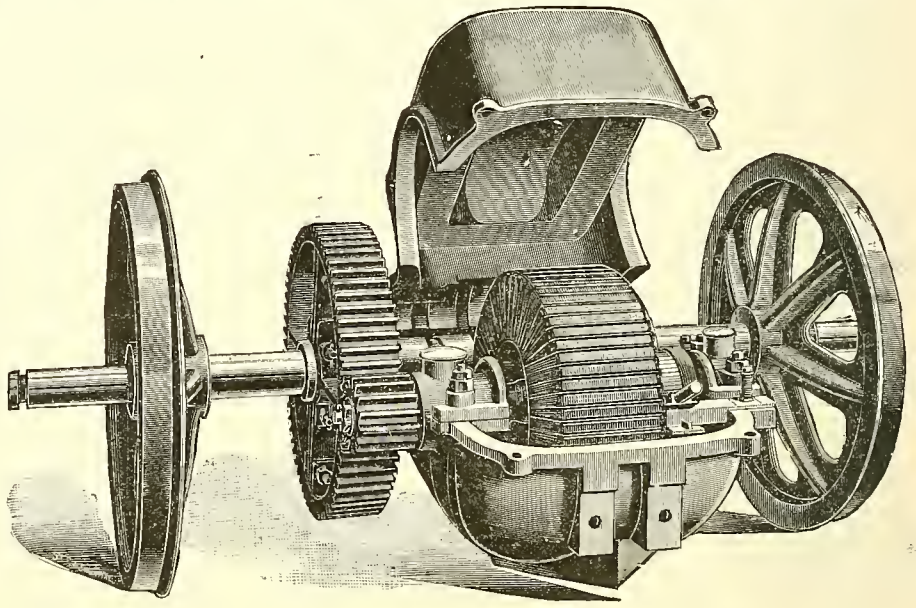

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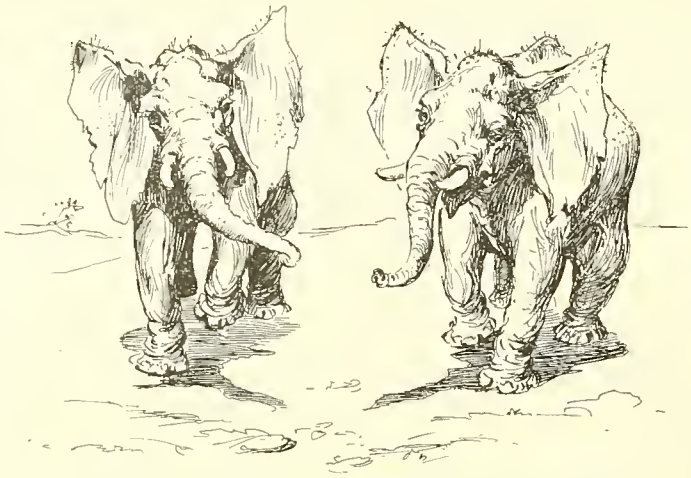

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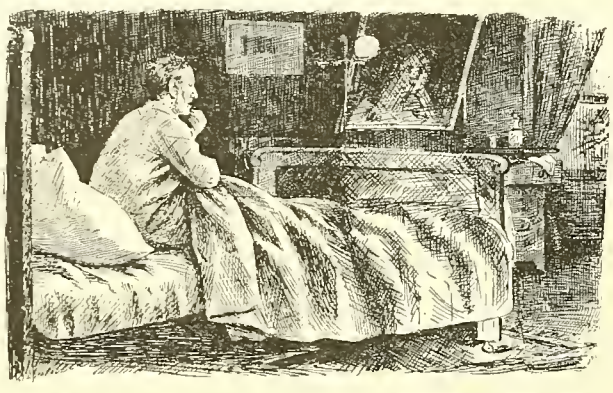

HAVEN'T you sat up in bed often, at night, wakeful, with the cares of the station driving sleep away for a time? Perhaps you saw a distorted reflection of yourself in the mirror across the room; and you'd ask yourself whether you really did look like that, or if you looked, to other people, like you did to yourself—(clock strikes three and the quarter)—and then your thoughts go trooping back to the station again, and you wonder if Henry thought to take off those old brushes and put on the set of Wirt Brushes that just came in by express. Queer, isn't it? how the ideas will chase through your head as you sit there all alone—you hear the subdued snore of the city—suddenly an alarm of fire startles on the still air; you count, mechanically, *two-four-two*, box; not anywhere near the station, and you feel relieved. Then you notice a red string tied to your finger and for five minutes you can't remember what it's there for, and then it all comes back--"Be sure and order two more miles of Shield Brand Wire first thing in the morning." A milk cart rumbles down the street and you wish it wasn't so deuced near time to get up--and before you know it you're sound asleep.

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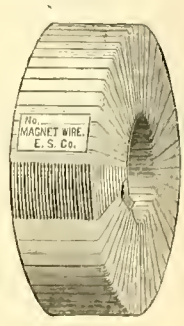

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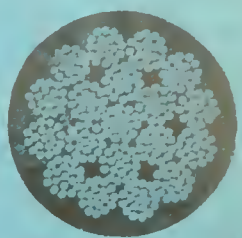
Feeder Cable, Brooklyn Edison Electric Light Co.

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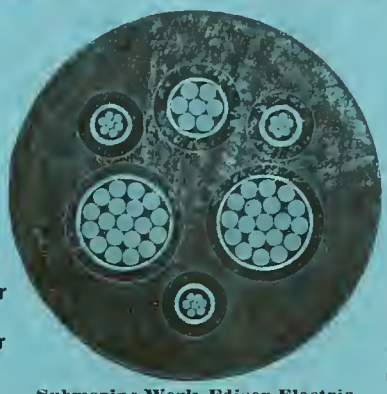
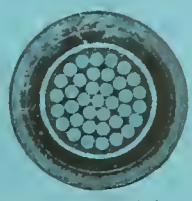
Feeder Core, Broadway Theater.


Submarine Work, Edison Electric Light Co., Easton, Pa.


Naval Core, United States s. s. "Chicago."

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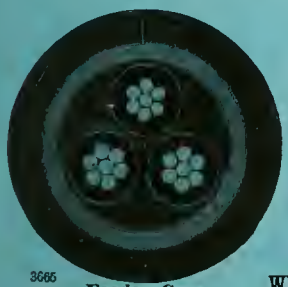
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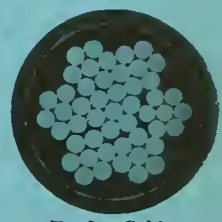
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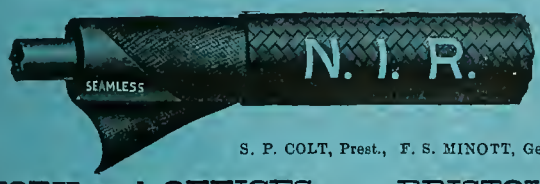

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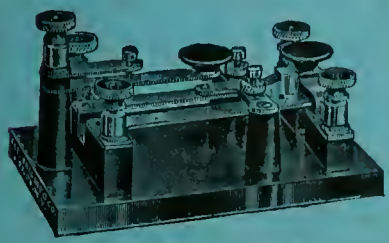

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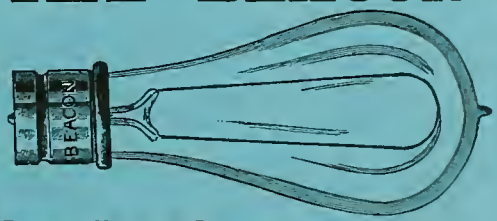

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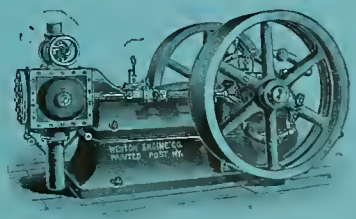

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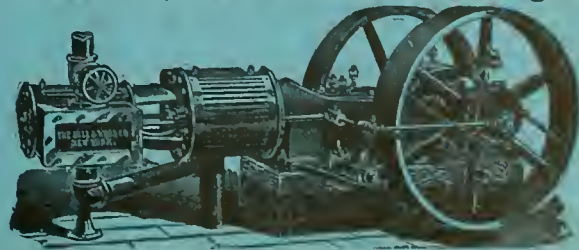

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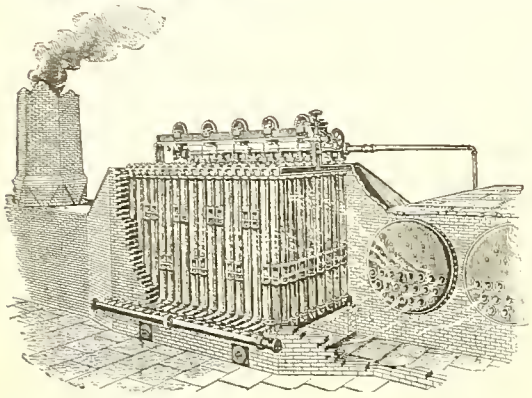

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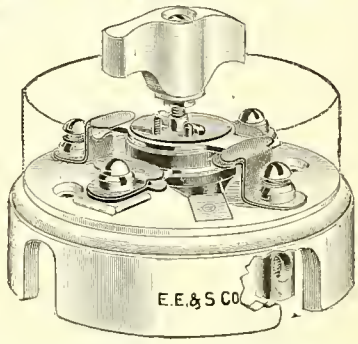

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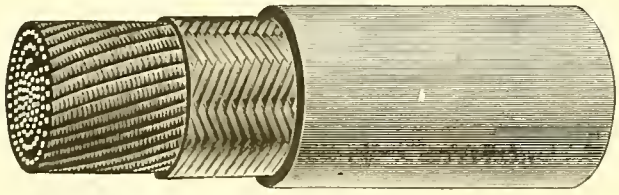

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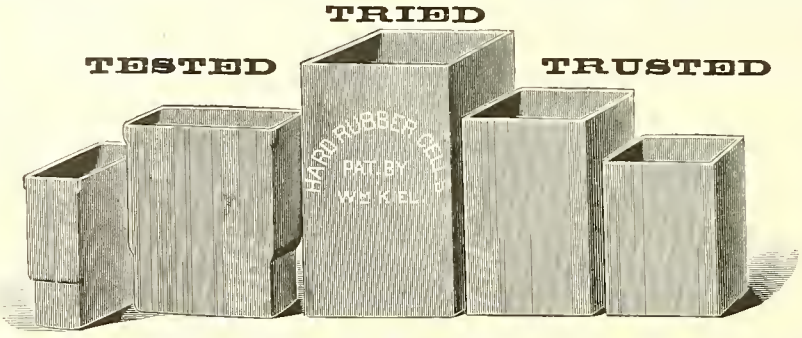

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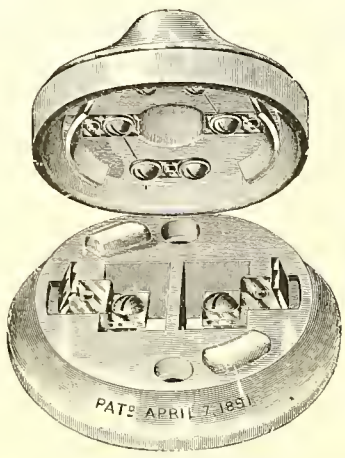

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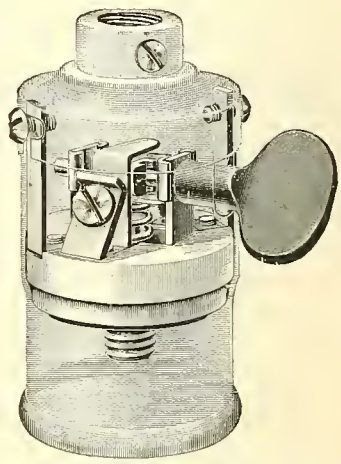

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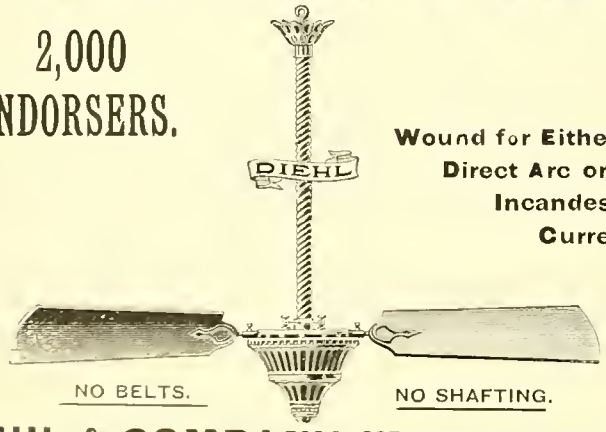

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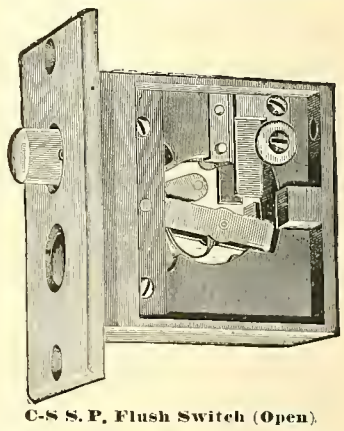

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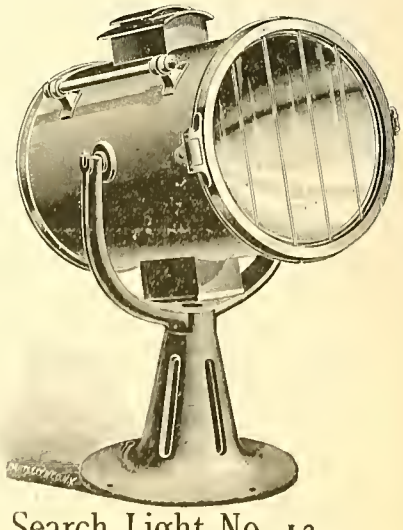

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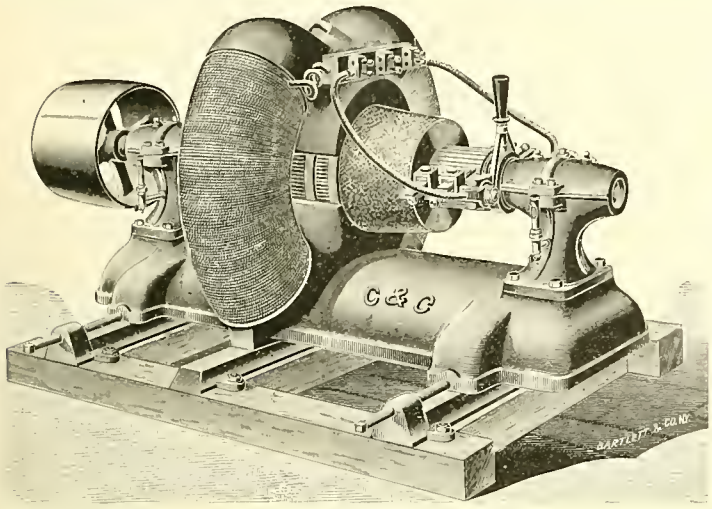

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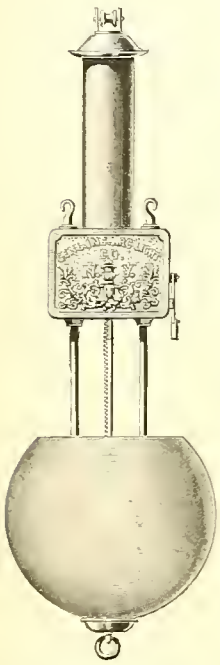

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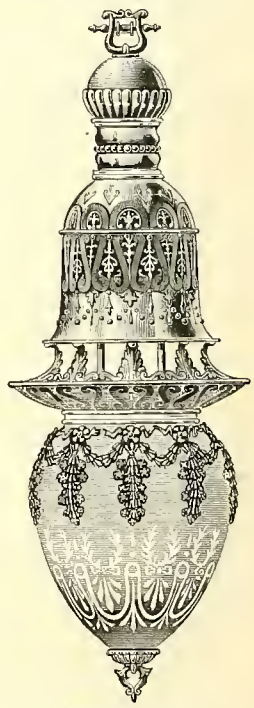

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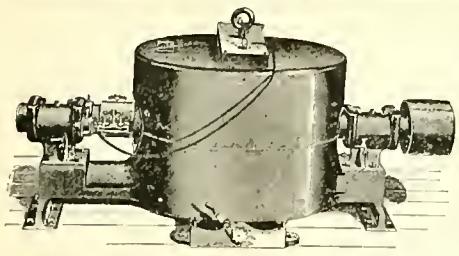

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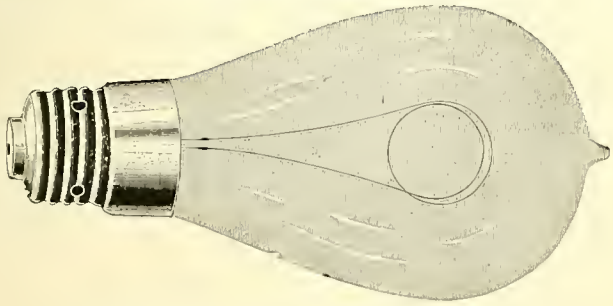

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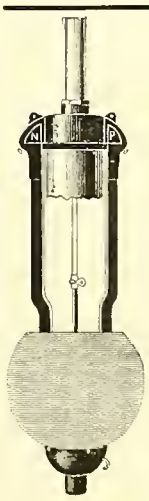

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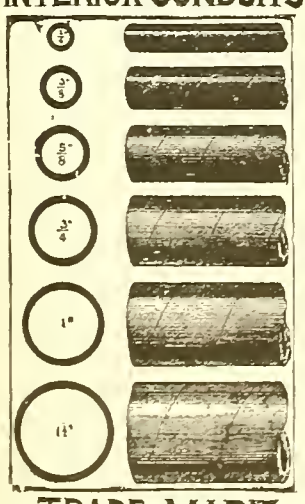

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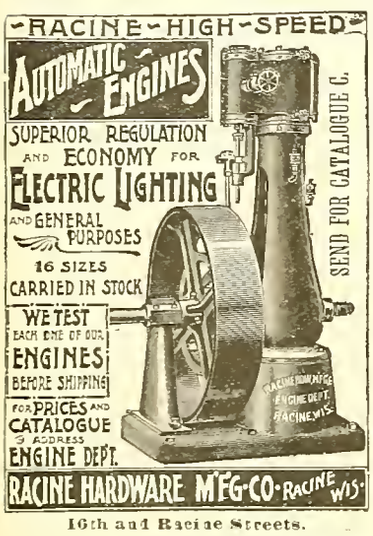

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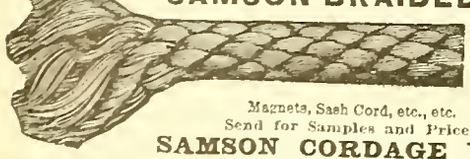

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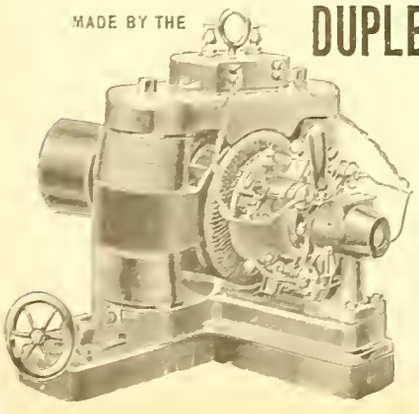

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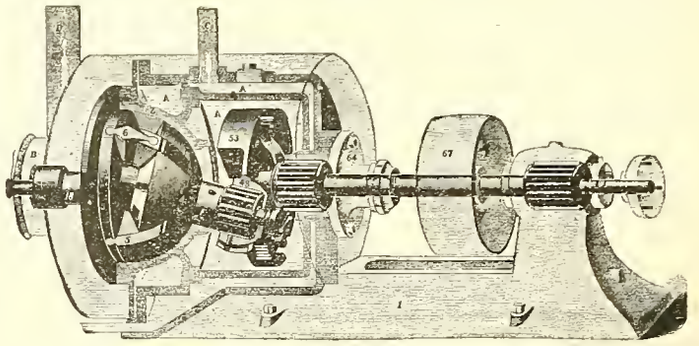

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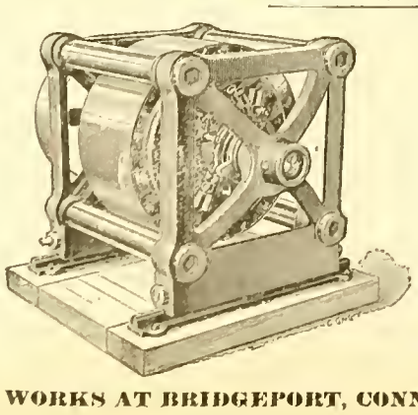

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Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, FEBRUARY 18, 1893. No. 7

Electricity at the World's Fair.

Before many months the temporary electric power and lighting station at the World's Fair will be a thing of the past, and current will be distributed exclusively from the central plant in machinery hall. When first installed the plant was described and illustrated in the WESTERN ELECTRICIAN (October 10 and November 7, 1891), but since then several additions have been made, chiefly in arc lighting machinery, and the capacity of the station greatly increased. A view of the plant, now at its highest point of usefulness, is presented in Fig. 1. Early in May—perhaps before—it is expected that the building will be torn down and the machinery put to other use. As originally put in operation the plant was, electrically, exclusively an Edison product, but the additions comprise a Wood and several Standard arc dynamos. The Edison machines include two incandescent dynamos not shown in the illustration, two 500 volt power generators and four of the queer-looking Edison arc machines, the manufacture of which, it is believed, has now been discontinued. The plant, under the efficient direction of J. H. R. Ward, has done good service and has proved of great value during the construction period, nearly all the power used on the grounds having been transmitted from it. It is a curious fact that, in World's Fair parlance, the "temporary" electric plant will have been in service a year and a half when discontinued, while the "permanent" installation is for six months' work. The latter, however, is so much larger and more elaborately fitted as to merit its designation.

The Westinghouse company's staff at the World's Fair will shortly remove from the horticultural building to the company's office building, south of machinery hall, which is now about finished. Two 4,000 light alternators, to be driven by the two 400 horse power Westinghouse engines recently illustrated in this paper, are now in position in the company's space in machinery hall, and two of the big 10,000 light machines are on the way from Pittsburg. Superintendent Reilly now finds it necessary to devote nearly his whole time to the work of installation in this building, and a temporary switch-board for use in connection with the two machines now on the ground has just been built under his direction. The iron work for the permanent switch-board is now up, and the indications are that the Westinghouse company will be able to furnish all the lights needed on May 1st. The new lamps are now in daily use in several of the buildings, and are reported to be giving satisfaction.

Two Eddy motors of 10 horse power each are being installed in the electricity building to operate two freight elevators, which have been temporarily placed in position to hoist exhibits and other material to the galleries. A similar installation is under way in the mines building. Four motors of the same company's manufacture have also been placed in the administration building, one in each pavilion. These machines are each of two horse power, and drive 36-inch fans, located at the top of ventilating shafts. Bids were opened on Friday of last week for the leasing of two 150 horse power motors to the World's Columbian Exposition company for the period of the fair. These motors must be wound for 500 volt circuits, and are to be used to drive a line of shafting in the mines building, from which stone crushers and other machines will be operated. The contract has not been awarded.

Under the direction of Superintendent Broadnax the New York Insulated Wire company is now doing wiring work for the Westinghouse company in nearly all of the buildings.

The recent severe weather has interfered considerably with outside work, but nevertheless 132 arc lamp posts have been set about the grounds, complete with lamps and globes. All told, there will be 1,350 of these iron posts used in the outside lighting of Jackson park and Midway Plaisance. The contractor is bound to erect them at an average rate of 25 a day, so that if he falls behind at any time he must make it up within the specified period.

One of the most striking features of the service arc lighting is the provision made for the illumination of the great space in the center of the manufactures building, outlined by the giant trusses which have attracted so much attention. These iron arches, the largest in the world, are something over 300 feet in span and are over 200 feet from the floor at the topmost point. Ordinary methods of suspension were therefore not available for the arc lighting of this space. After careful consideration a plan was evolved by Luther Stieringer, consulting electrical engineer to the exposition, and the details have since been worked out by the arc light bureau of the electrical engineering department. Illumination will be diffused from five coronas—mammoth arc electroliers—suspended from the apex of the trusses. The largest of these, details of which are illustrated in Figs. 2 to 5, will be hung in the center of the building, with two others on either side, on the north and south axis of the structure. The center corona will be 75 feet in diameter and the others each 60 feet. Arc lamps of 2,000 nominal

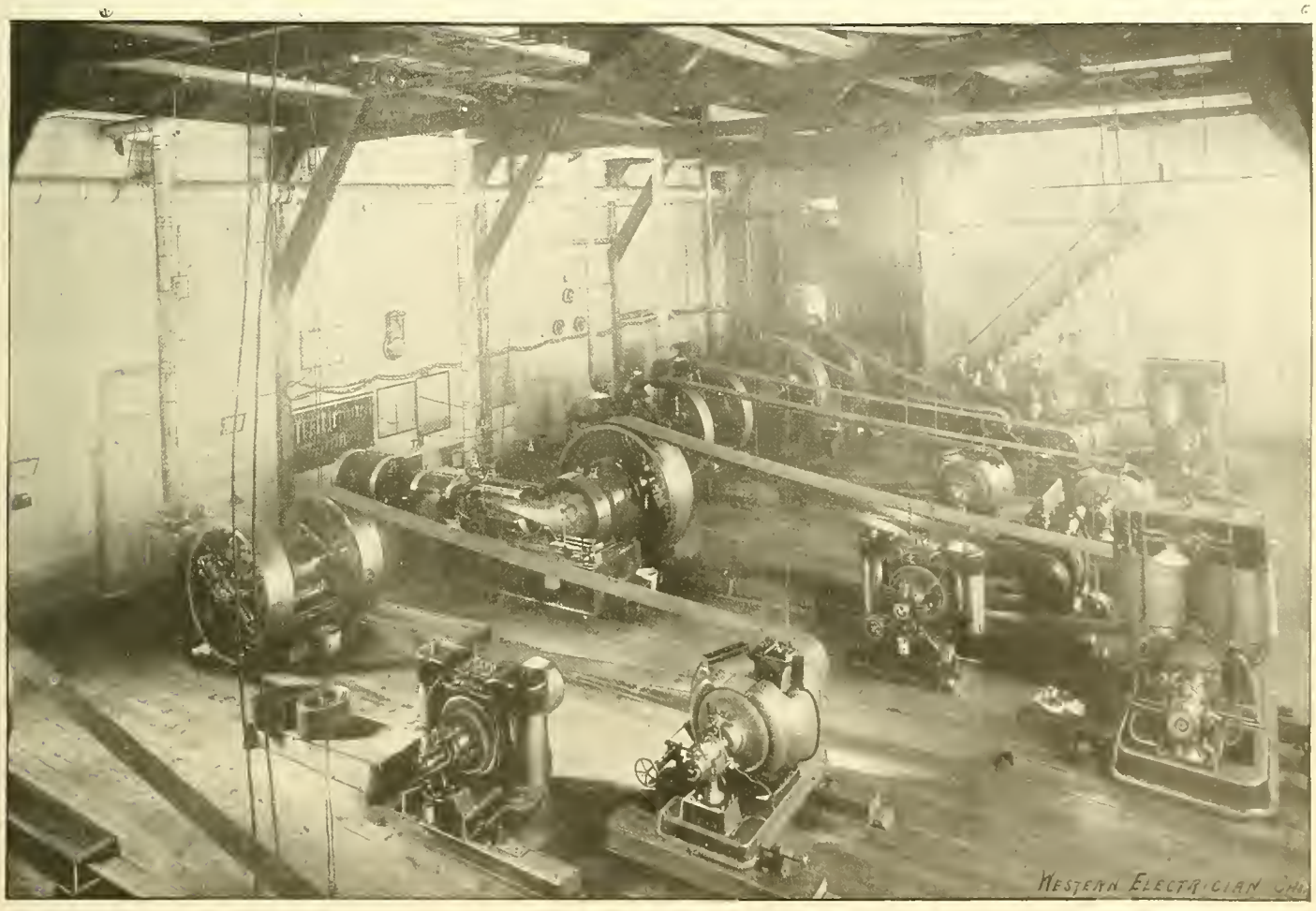


FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.

candle power each, to the number of 102, will be hung from the largest corona, while each of the others will have 78, making a total of 414 lamps to illuminate the space under the trusses. The groups of lamps will be 66 feet below the highest point of the arches and 140 feet above the floor. The center corona, which may be taken as a type of all, is constructed of angle iron, with a bridge in the center, as indicated on the plan, Fig. 2. It is suspended by a steel shaft in the center, indicated more clearly in the side elevation, Fig. 3. This shaft contains a ladder, by means of which the lamp trimmer, having mounted to the center of the arch, descends to the platform of the corona. This platform is two feet nine inches wide and is of course circular, coincident with the circumference of the structure. It is protected by railings on either side, shown in the enlarged vertical section, Fig. 5. The shaft is two feet in diameter. The lamps are arranged in star shape and are suspended over davits by steel cables, Fig. 5. The arrangement is shown more in detail in Fig. 4, which represents a small section of the corona looking from above. The lamps are hung in twos, to balance each other, and will be provided with opal globes. To thoroughly insulate the lamps from the iron structure the suspending cables will pass through specially designed rubber thimbles at the point of attachment. The lamps will be burned on 50-light circuits, and 24 of them will be wired on a separate circuit and burn all night.

In reply to the charge that New York state had been discriminated against in the matter of the allotment of space, Mr. Hornsby shows that in the electricity building at least the reverse is true. The best space in the building has been given to New York exhibitors, and in all exhibitors from that state have about 40,000 feet of space. The General Electric company alone has 15,000 feet of the choicest space on the lower floor.

One of the interesting historical exhibits in the electricity building will be a duplication of the apparatus used by Prof. Moses G. Farmer in his early experiments in electric traction and incandescent lighting.

H. D. Wilkinson, who has written a series of articles on "Submarine Cable Laying and Repairing," has been appointed engineer to the British section of the exposition, and will sail from England about February 20th. Mr. Wilkinson has had considerable experience in exhibitions. At the Paris exhibition of 1889 he was in charge of Davey Paxman's exhibit, in 1891 he was responsible for the electric lighting of the Naval Exhibition, and at the Crystal Palace Exhibition of last year Mr. Wilkinson also held an important post.

In the big power plant electricity will be applied to every feature where automatic control is possible. All of the boilers in the plant are supplied with burners for oil, the only fuel used. The valves of the burners are connected by electricity with the pressure gauge, so that a rise in the pressure of steam decreases the flame of the burners, preventing the waste of fuel and unnecessary pressure in the boilers. If only one 1,000 horse power boiler is in use and it is necessary to start up ten or fifteen more boilers the demand for more oil is indicated automatically at the oil tanks and supplied by the opening of electrically connected valves in the tanks and oil pumps. The water supply is regulated in the same way. The instant water gets low in a boiler the gauge signal opens a valve in the feed pump at the pumping station. In addition to all these regulators each boiler has a duplex signal which rings an alarm when the steam or water rises or falls to the danger point.

Contracts have been let for the construction of 4,500 feet of movable sidewalk on the casino pier. The sidewalk is designed principally to carry passengers arriving by steamboats from the lake end of the pier to the shore, 2,500 feet westward. The Pier Movable Sidewalk company owns the concession. Pullman's Palace Car company has the contract for the entire rolling stock, the General Electric company for the motors and electrical equipment, and Hiero B. Herr & Co., the contractors who have just finished the pier, will build the sub-structure for the moving platforms. The plans call for the movable platforms to be five feet above the floor of the pier so as to afford to all its passengers an elevated and unobstructed view of the shore and lake.

The leaky roofs of the exposition buildings have interfered considerably with electrical work. In machinery hall especially delay has been caused in the installation of the lighting and power plant by the inpouring water and snow.

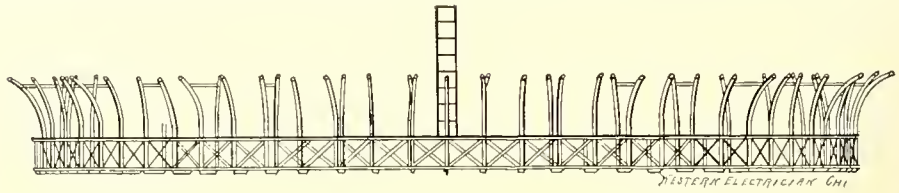


FIG. 3. ELECTRICITY AT THE WORLD'S FAIR.

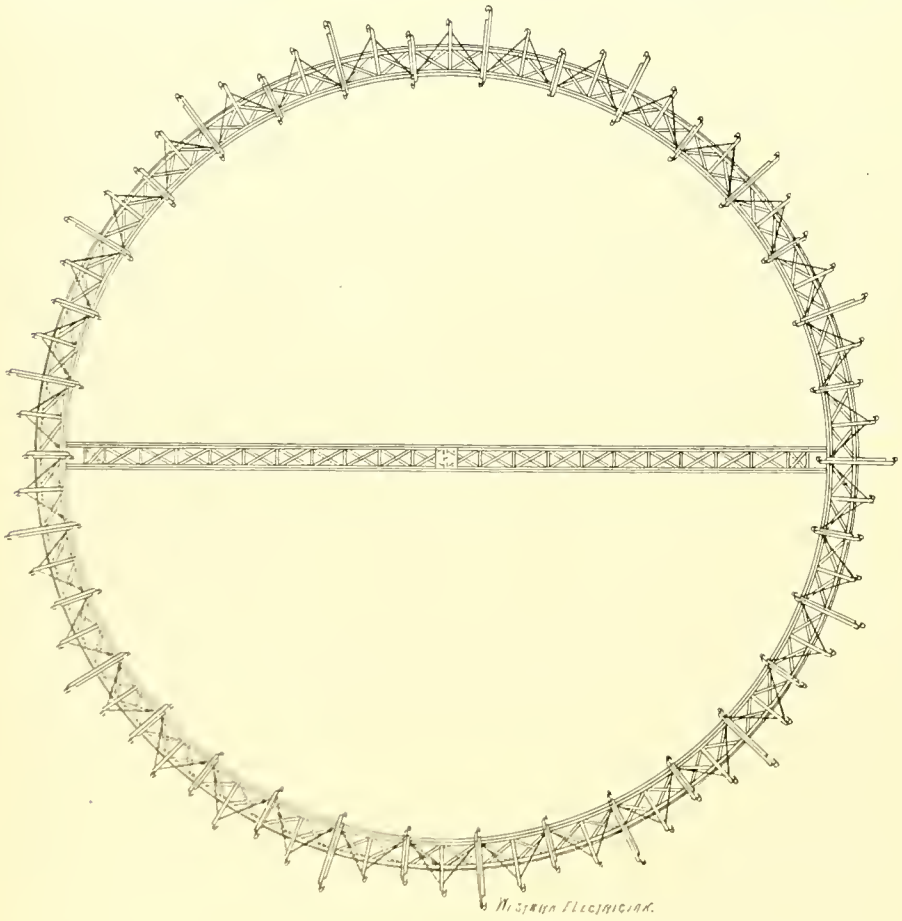


FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.

A movement is on foot for the consolidation of the three electric lighting companies of Ottawa, Ont.

National Electric Llight Association.

Members of the National Electric Light association look forward to the meeting in St. Louis on February 28th as the most important convention in the history of the organization, and it is expected that the attendance will be greater than at any former electrical gathering in this country. In view of the fact that there has not been a convention since the Buffalo meeting a year ago, it is reasonable to expect a large gathering. Preparations for the meeting in Chicago during the World's Fair will be made at the St. Louis convention. It is expected that there will be an unusually large number of western members at the St. Louis convention. Chicago will send a large party, and at present an effort is being made to secure a special train for residents of the World's Fair city. The eastern delegation, it is expected, will be as large and representative as usual. There are many points of interest for visitors, and electrical engineers will find much to admire in the electrical equipment of that city. The electric railway system and the electric lighting stations are among the largest in the country, and President Ayers will afford the members of the association every opportunity of seeing the plants.

It is announced that Professor George Forbes of London will, in all probability, attend the St. Louis meeting of the association, and, if he can find time to do so, will prepare and read a paper. In addition to the lecture by Mr. Tesla, in which he will give practical demonstrations of high frequency currents, papers will be read by Mr. Sterling on "Some Experiences with the Alternating System," Mr. Bradley on "Long Distance Transmission of Power," Mr. Stillwell on "Under What Conditions Is the Use of Water Power Economical?" Mr. Myers on "Preservation of Poles and Cross Arms," and Mr. Townley on "The Incandescent Lamp." Messrs. Stanley, Brophy, Bell, Armstrong, Browne and Adams have not yet announced the subjects of their papers.

An excursion rate of a fare and a third has been granted to St. Louis and return for delegates by all the passenger associations except the Western, with which negotiations are now pending. Arrangements are now being perfected for a special train to carry the eastern delegation, which will be vestibuled and electrically lighted, and composed of dining, buffet, observation and sleeping cars, and will leave New York, via the Pennsylvania railroad, from the stations at the foot of Cortlandt and Desbrosses streets, Sunday, February 26th, at 12 o'clock noon; Philadelphia, 2:25 p. m.; Harrisburg, 4:25 p. m.; Pittsburg, 10:40 p. m. (central time); Columbus, 4:35 a. m.; Indianapolis, 10:30; a. m.; arriving at St. Louis at 5:30 p. m., Monday, February 27th. The rate for berths is $6 each; drawing-rooms, $22 each.

For the convenience of passengers taking this train from New York, arrangements have been made so that if they will remit to C. O. Baker, Jr., master of transportation, the amount of railroad fare ($24.25) with the sleeping-car fare ($6), a receipt will be mailed them that will be honored by the railroad company for checking baggage, ferry passage, and passage through the gate at Jersey City, and exchangeable on the train for regular ticket and certificate.

The Boston passenger committee has declined to sell tickets at a reduced rate from Boston via New York; therefore the eastern delegates who desire to take the electrical special will be compelled to come to New York, purchase tickets, and secure certificates from New York to St. Louis and return. It is quite important that all the names of delegates who will be passengers on the electrical special should be known as soon as possible. The following named gentlemen have charge of transportation matters in their respective territories: Morris W. Mead, Pittsburg, Pa.; Fred. W. Royce, Washington, D. C.; John Carroll, Montreal, Canada; A. C. Shaw, Boston, Mass.; H. A. Cleverly, Philadelphia, Pa.; M. J. Hart, New Orleans, La.; John W. Flinthan, Denver, Colo.; J. Scribner, 173 Adams street, Chicago, Ill.; Louis Nahm, St. Louis, Mo.

To secure the benefit of the reduced fare returning, it will be necessary for those who do not go by the electrical special to be sure and state to the ticket agent, at the time they purchase their ticket, that they purpose attending the

meeting of the association in St. Louis, and procure from him a certificate which will entitle them, when properly countersigned, to return for one-third the regular fare. No reduction can be obtained without this certificate. Immediately upon arrival in St. Louis, these certificates should be left at the secretary's office, addressed to Mr. Baker, who will see that they receive proper attention and are returned to the owners.

Consolidation of the Chicago Electric Lighting Companies.

The consolidation of the two principal electric lighting companies of Chicago, recently referred to in the WESTERN ELECTRICIAN, has been consummated. The Chicago Edison company has secured a controlling interest in the Arc Light & Power company of Chicago, and hereafter both concerns will be conducted under the same management. The Chicago Arc Light & Power company has issued a circular letter to stockholders, from which the following extract is taken:

The principal stockholders of the Chicago Arc Light & Power company, owning over two thirds of its outstanding capital stock, and including all of its directors and officers, have accepted the proposition of a syndicate represented by Erskine M. Phelps to purchase at any time prior to March 10, 1893, their shares in said Arc Light company for the sum of $120 per share, payable in the 5-20 6 per cent. debentures of the Chicago Edison company, drawing interest from Jan. 1, 1893; interest payable semi-annually on July 1 and Jan. 1 in each year, earnings from Jan. 1, 1893, upon the shares sold to go with the stock. A condition of this sale was that an opportunity should be extended to all stockholders to sell their holdings to the same purchasers upon the same terms.

It is understood that the purpose of the purchasers is to vote this stock in a lawful manner for the consolidation of this company with the Chicago Edison company under the provisions of the Illinois statute concerning consolidation of corporations. The undersigned believe such consolidation to be for the interest of both companies and the public. The business has changed since we undertook it six years ago. The modern tendency is to furnish all kinds of service, arc and incandescent light, heat and power, not only from the same station but from the same circuit. The result is that while the two companies occupy rather different fields both in lighting and power, our plans for future extensions almost parallel those of the Edison company—duplicate stations, double tearing up of the streets all over the city, etc. Every consideration of common sense and economy points to consolidation and simplification of plant and operations, and some of the undersigned, among them the president, favor it for the additional personal reason that they wish to retire from the responsibility and care of our company's management. We believe that the terms are equitable, and have accepted them for ourselves, and recommend all stockholders to do the same.

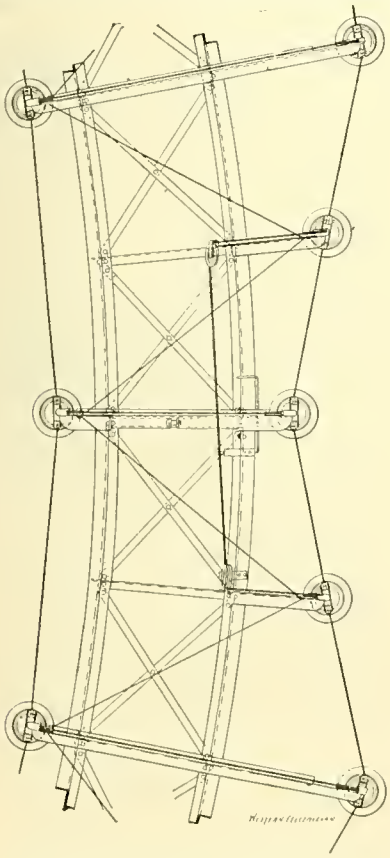


FIG. 4. ELECTRICITY AT THE WORLD'S FAIR.

The proposition to purchase expires March 10th, after which time Mr. Phelps does not agree to accept further offerings.

Action to Annul the Berliner Patent.

On February 9th Attorney general Miller filed a complaint in the United States Circuit Court for the district of Massachusetts at Boston against the American Bell Telephone company and Emile Berliner, asking for the annulling of patent No. 463,569 for a combined telegraph and telephone applied for by Berliner on June 4, 1877, and issued Nov. 17, 1891, to the American Bell Telephone company as Berliner's assignee. The grounds upon which the application for annulling the patent is made are

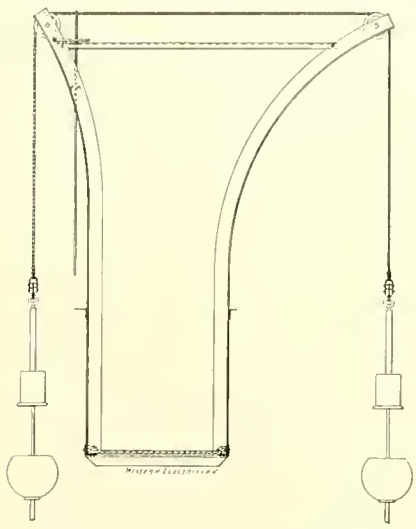


FIG. 5. ELECTRICITY AT THE WORLD'S FAIR.

that claims set up in the Berliner patent are covered by previous patents issued to the Bell company, that the possession of the patent, if valid, will continue to the Bell company without substantial diminution during the full term thereof with the same close monopoly of the art, and that it is against the spirit and intent of the patent laws and against justice and equity that the monopoly of one and the same invention shall be prolonged in one and the same person by the grant first of a patent or patents for the invention in practical and applied form and afterward of a patent covering nakedly and broadly the fundamental principle of the same invention.

The Berliner telephone was illustrated and described in the WESTERN of ELECTRICIAN November 28, 1891. At that time there was a wide diversity of opinion as to the commercial value of the patent which had just been issued. It was conceded that if the patent was allowed to stand the Bell company's monopoly would continue, but there were few who would commit themselves to the probability of the government tolerating this protracted monopoly. It is not contended by the Bell company that the Berliner patent covers a practical or commercial instrument, or an improvement upon the telephone now in use, but on the contrary, as one of the company's most reliable experts said at the time of the granting of the patent: "This patent covers the fundamental principle of a transmitter, and, while the drawing represents a very crude instrument—one that would not be used to-day and would, in fact, be considered impracticable—it is unquestionably a fundamental patent and a valuable one, too."

The Bell company has relied entirely heretofore upon its receiver patent, but now it is believed it will endeavor to continue its monopoly through the Berliner transmitter patent.

Rapid Transit Between Chicago and Evanston.

Residents of Evanston avenue and other thoroughfares leading from Chicago to the suburban districts as far north as Evanston are persistent in their demands for improved facilities for reaching Chicago. They have abandoned hope of obtaining relief from the extension of the North Side cable system, and are now engaged in securing the right of way for an electric road. The property owners have held several meetings to consider plans, and it is reported that a company will be formed to build an elevated electric line, to be equipped with the Johnson system, which was illustrated in the WESTERN ELECTRICIAN of December 3d.

Patent Commssioner's Report.

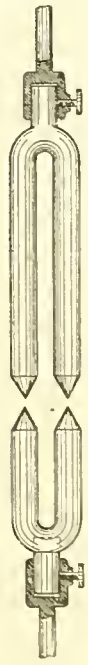
In the annual report of the commissioner of patents attention is directed to the exhibit which the department will make at the World's Fair. The report says: "For more than a year past the preparation of a Patent Office exhibit for the World's Columbian Exposition at Chicago has been in progress. It has required the expenditure of a great amount of care, thought and labor, which the office could not afford to spare; but the result is gratifying. The exhibit comprises upward of 2,500 models, nearly all of them working machines in all except size. These include 93 models of dynamos and motors, 19 models in the electric lighting classification, 30 in telegraphy and 40 in telephony. Special mention is made of the last named exhibit as follows: "In telephones substantially the whole history of the art is presented in the exhibit, beginning with the Bell telephone of 1876 and showing the important improvements down to the latest telephone used to-day. In this exhibit of the models on file in this office twenty have been selected, and nearly twenty more are to be loaned by manufacturers."

New Form of Carbon for Arc Lamps.

James McLaughlin of Chicago has devised a new form of carbon for arc lamps by means of which, it is claimed, the duration of service without replacing the carbons may be made two, three or four times as great as where the old form of single carbon was used in the same lamp. One form of these carbon pencils is shown in the accompanying cut. Another object of the invention is to provide means by which carbons of this kind may be interchangeably attached to or detached from different lamps of the same construction, or from different lamps the operating mechanism of which is dissimilar, dispensing entirely with the necessity of employing separate, or auxiliary devices for effecting an attachment or detachment.

The socket ends of the pencils are made to fit the sockets of lamps now in use. The ends are only long enough to project slightly beyond the sockets where their outer parts are expanded, laterally, far enough to hold two or more pencils or members which are parallel to each other. These pencils are placed far enough apart to prevent the electric current from leaping from one to the other. In this construction the members of the carbons are, preferably, all molded integrally into a single element, but the different parts may be engrafted upon each other, as seen in the lower carbon, where the socket-piece is shown inserted, as indicated by the dotted lines, into the bend or part uniting the members.

The operation of the device is obvious. The electric current will pass through the pair of opposed members



NEW FORM OF CARBON FOR ARC LAMPS.

which offer the least resistance. Whenever the distance between their points, through burning away, becomes such as to offer greater resistance to the electric current than is presented by another pair of opposed pencils, the current will establish its course through the latter pair of pencils and continue in that course until another pair of opposed pencils offers an easier passage for the current, when that course will be adopted. This will be continued until, finally, through the increased resistance between the positive and negative sides of the lamp, thus produced, the feeding mechanism is forced into action, after which the same operation of the current takes place, as before.

It is claimed that where there are two members, each of the same cross-section as the old single lamp carbon, the duration of the light will be twice as great as where only the

old single carbon was used in the same lamp, and that it will be proportionally greater where three, four, or more pencils form the members of a carbon.

Electricity in the French Navy.

Applications of electricity are increasing day by day, not only in cities but wherever it is necessary to produce, light or transmit power, says a writer in *La Nature*. War vessels especially are constantly extending the field of its usefulness, and it is interesting to note some of the most recent of the applications on shipboard. The first experiments with electric lighting were made in 1867, when a projector was introduced on the yacht Reine Hortense. The dynamo was a magneto machine. Constant study was devoted to the problem, and in 1877 Gramme dynamos operated by Brotherhood engines were installed on the warships Richelieu and Suffren for the single purpose of furnishing current for the projectors. The incandescent lamp made its appearance in 1881 at the Electrical Exposition in Paris. Immediately Saulter, Lemonnier & Co., undertook to install the lamps for inside lighting, and the results were entirely satisfactory.

Electric lighting on shipboard presents many advantages

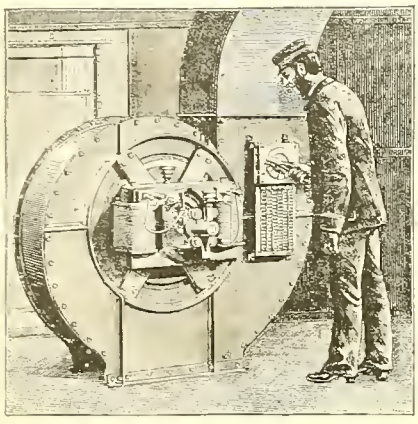


FIG. 3. ELECTRICITY IN THE FRENCH NAVY.

as compared with other means of illumination. The operation of the dynamos requires only a small amount of steam in comparison with the volume necessary for propelling the ship and the cost is relatively small. The danger of fire is greatly reduced if the plant has been properly installed. Most of the ships in the French navy are now electrically lighted. Among the battle ships may be mentioned Admiral Courbet, Morceau, Redoutable, and Admiral Boudin.

Generally the dynamos on the ship are coupled to vertical engines of about 350 revolutions. The machine which is most frequently used on French ships is the Gramme multipolar dynamo, though a number of other makes have been installed. The firm of Saulter, Harle & Co. has just constructed a new combination for use on shipboard, which is illustrated in Fig. 1. This plant is to be installed on the battle ship Magenta. The capacity of the dynamo is 32 kilowatts at 350 revolutions. The potential of most dynamos installed for ship lighting is 70 volts; that of the new machine is ten volts greater.

For outside lighting electric lamps have given great satisfaction on shipboard. At the left of Fig. 1 is shown one type of a vast number of signal lanterns employed. Fig. 2 illustrates the use of projectors at the top of the mainmast. With the search lights at this point the light is distributed over a considerable range and at the same time is projected to a great distance.

Electricity is also used to transmit power on ships instead of steam or hydraulic pressure, which are inconvenient and cumbersome. Fig. 3 illustrates a ventilating fan operated by a Saulter, Harle & Co. electric motor. A convenient tool is that shown at 1 in Fig. 4, a drill operated by an electric motor through a flexible shaft. In 2 in the same figure is a centrifugal pump also operated by a small electric motor.

American Institute of Electrical Engineers.

The annual election of officers of the American Institute of Electrical Engineers will be held at New York on May 16th. This will be the first election under the new method of choosing officers, which was proposed at the Chicago meeting last year and approved at the first meeting of this season, which was held in New York on September 27th. The amendment to the rules which embodied the changes in the manner of making selection of officers was published in the WESTERN ELECTRICIAN of September 24th. Lists of members will be furnished by the secretary.

Electric Railways in New Hampshire.

New Hampshire has caught the fever at last, and is now about to engage in the electrical railway business with a vigor that will atone for its tardiness in the past. Two great schemes are now before the Legislature of that state, and a new element has entered into the traditional railroad fight which has been fought out in this body every session for nearly a generation past. The steam roads will have

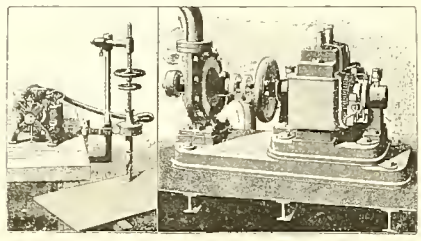


FIG. 4. ELECTRICITY IN THE FRENCH NAVY.

to stop fighting one another and turn their attention to the rival electric systems. The first project is for a system of electric railways which embrace the whole Merrimac valley. The idea is to unite the street railway interests from Lake Winnipeseogee to the sea and form a continuous line for passenger and freight traffic from the heart of the summer resort region of New Hampshire to the seashore resorts of Massachusetts. It's a big scheme, but it has money back of it, and if it can run the gauntlet of the railroad lobby in the interests of the Concord railroad and the Boston & Maine railroad it stands a good show of becoming a fact. The first move in the matter is in the action of seval of the street railway companies in that section in asking for larger powers than are now granted by their charters. The street railway company at Lakeport, on Lake Winnipeseogee, Concord, and Nashua have asked for fuller powers. There is one link in the proposed system that is not covered by any road now in operation. That is between Concord and Manchester. To provide for this a bill has been introduced in the Legislature which will require a road to be built through the towns of Hodsett and Pembroke. When this came up for action it was referred to the committee on railroads, which reported that it was "inexpedient to legislate." The railroad lobby had gotten its work in on this, but the promoters of the new scheme, not discouraged, at once introduced a petition for a charter for a road to be built by the Hodsett & Pembroke Street Railway company. The Concord Railroad company appeared by counsel before the railroad committee and opposed the granting of the charter on the ground that it would parallel its road. Each road in the proposed Merrimac valley system that has not already a charter that will permit it to extend its lines is asking permission. The Manchester road is supposed to have this right now, but the Massabesic Horse Railroad company, an allied corporation to the Manchester Street Railway company, has asked permission to issue bonds and build new lines. To reach Manchester Nashua will only have to build across the town of Litchfield.

The Concord Railroad company, beside antagonizing this scheme of electric extension, has one of its own to work. This would also furnish direct communication between Central New Hampshire and the Massachusetts and New Hampshire beach resorts, but not entirely by electricity. This company has secured control of the Exeter and Epping railroad, which is proposed but not yet built. It will complete its construction and then get control of the charter for a railroad from Exeter to Hampton Beach, which it will construct as an electric line. It is said that the Concord company would then build electric lines each way from Hampton beach till it had the entire line of seashore resorts in New Hampshire covered. By that time the Massachusetts beaches will all be connected by electric roads, and New Hampshire people will have facilities for reaching these places such as they have never had before.

The second great scheme before the Legislature is that of an electric road up Mt. Kearsarge. Albert P. Davis, Col. G. L. Ordway and other prominent men of Warner are interested in it and have asked the Legislature for a charter. The proposed road would start at Potter Place on the Northern railroad, and follow through the valley to Wilmot and the northern base of the mountain. It would

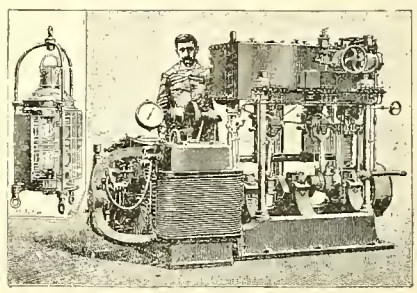


FIG. 1. ELECTRICITY IN THE FRENCH NAVY.

climb the mountain to within a short distance of the summit, when it would descend the southern side to Warner village, where connection would be made with the Concord and Claremont railroad. It would be fourteen miles long and would run through some of the prettiest scenery in the state. This mountain has been a popular summer resort for years, but has been hard to reach.

A charter has also been asked for an electric road to run from Manchester through Bedford to the Uncanoonuc mountains in Goffstown.

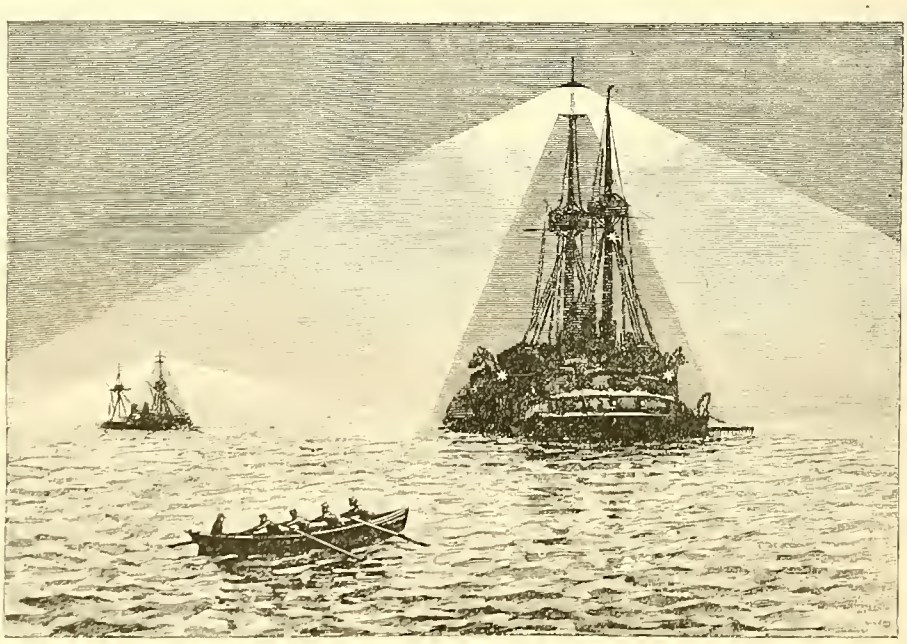


FIG. 2. ELECTRICITY IN THE FRENCH NAVY.

Justice Brayton recently fined the Chicago Illuminating company $25 for violating the smoke ordinance. The company operates an electric light plant in the rear of 3036 Indiana avenue. The defense was the impossibility of getting a good quality of coal owing to the present lack of coal in the yards. The company promised to improve the smoke-preventing devices in use in the plant. In view of these facts the court did not impose the full penalty.

Underground Construction.[1]

By W. A. Tower.

The first work of burying wires in America was done in Washington, D. C., but I believe the system did not work satisfactorily, and is to be, or has been, remodeled. The next work of any importance was done in Chicago, when the drawing-in system was adopted for telephone work. A drawing in system is one where any number of ducts can be laid and used at any time without having to dig them up, or to lay the cables at the time the conduit is built. This system does not necessitate the use of any particular material or make of conduit.

In building an iron pipe conduit, after the trench has been dug, a layer of concrete about three inches thick is laid, wide enough to allow an inch or more between each pipe, and three inches on each side. A row of pipes is then laid, varying in length from 14 to 22 feet. These are screwed together by regular threaded couplings. After this is done, concrete is put on, filling up the spaces between the pipes and the three inches on each side. The concrete is then leveled about one inch above the pipe. Another row of pipe is then put down, and the process repeated until the proper number of ducts has been laid. The top layer of the pipe is then covered with three inches or more of concrete, and the trench filled in.

The cement-lined pipe comes in lengths of about eight feet, with beveled male and female ends, and is laid in the same way as the iron pipe. The joints are made by bringing male and female ends together, and covering the junction with neat cement.

The Wyckoff conduit consists of pieces of thoroughly creosoted wood, about 8 feet 4 inches long, 4½ inches in diameter, with a 3 inch hole through the center, the ends counter-bored and tenoned. There is first laid a 1½ inch board in the bottom of the trench, which is wide enough to hold the proper number of ducts. The ducts are then laid on this, layer by layer, the joints being made by joining the male and female ends about half the length of the tenon, when hot pitch is poured in, and the lengths then driven together. After the ducts are all laid, another board is placed on top to protect them from the picks of workmen digging across the line of the conduit.

This all appears very simple to those who have had no experience with this work, but some of the difficulties which have to be overcome are by no means trifling. In the first place, after deciding upon the route to be followed, it is necessary to find out whether there is room enough on the street to lay the conduit, as the gas mains, water mains and other pipes may have been laid before the conduit was thought of. The engineer or superintendent of construction applies to the city and gas company for the location of their mains, which information, as a rule, is given very graciously, but in three ont of five cases the position given is not correct within two or three feet, and about the only use made of the information is to tell on which side of the street the mains are, and, consequently, test holes have to be dug to locate the pipes before the work can be started. As a general rule the bottom of the conduit is put below the level of the gas mains, and when a corner is reached it is often necessary to carry part of the ducts over the mains, and part under them. In some of the larger cities of the United States where there are two or three gas companies, the conduit trenches at street intersections often have to be as deep as ten feet, on account of the numerous pipes that cross at such points. The manholes are usually located at street intersections, and consist of chambers about seven feet long, five feet wide, and seven feet deep with brick walls laid in cement, and a cast iron head and cover generally made to bolt down tight to keep out water. After the conduit is laid and manholes built, an entrance must be obtained to the telephone building, which too often has been constructed without proper consideration for the handling of cables. The largest telephone exchange in the United States has this fault: the first cables were pulled into the bottom ducts, and it was found that it would be impossible to ever get at them again. The consequence is, that if a cable gives out it will have to be left, and the duct sacrificed. I do not think there are two exchanges which have the same appliances for handling cables, every engineer having a different idea as to how it should be done, and as yet a perfect system has not been adopted anywhere.

In pulling in cables, we first have to get a rope through the duct. This is done with wooden rods, about four feet long, equipped with malleable iron couplings. A rod is inserted into the duct which is to be used, a second one jointed on to it, and both pushed into the duct; this process is repeated until the rods extend to the next manhole. A rope is attached to the first rod, and the rods and the rope pulled back into the first manhole, and the rods uncoupled as they are pulled in. The rods are handled quite easily, two men being able to rod 400 feet of conduit in about 15 minutes. The rope is then fastened to an iron clevis, about 10 inches long, made to fit the cable, and riveted on to the end of it. The reel of cable being on the holder, the cable is then ready to pull in, which is done with a winch geared to an upright shaft with a sliding drum, and so arranged that the drum can be placed exactly opposite the duct through which the cable is to be drawn, thereby avoiding pulling the cable around or over any corners of the conduit.

After the cables are in, the splicing has to be done. This operation requires great care, and only thoroughly reliable men should be employed. In making a splice, the cables from each way are bent into their proper places in the manhole, and then cut to the proper length, which allows the ends to lap about a foot. The lead is then stripped off each end the length of the lap, and a piece of lead pipe, large enough to cover the wires when spliced, is slipped over one of the ends, the wires are separated in pairs and turned back as far as the lead is stripped.

1. Abstract of a paper read before the Canadian Electrical association, Toronto, January 26, 1893.

Two pairs of the bottom wires, one from each end, are then taken, and the insulation stripped off, care being taken not to nick the wires. A paper sleeve is put on one end of each wire, the wires twisted together, and the sleeve slipped back over the junction of the wires. After all the pairs are joined in this way, they are boiled out with hot paraffin, to vaporize any moisture that may have been absorbed while making the splice. A piece of paper is bound around all the wires to keep the paper sleeves in position; the lead sleeve is now pulled over the splice, and a regular plumber's joint wiped.

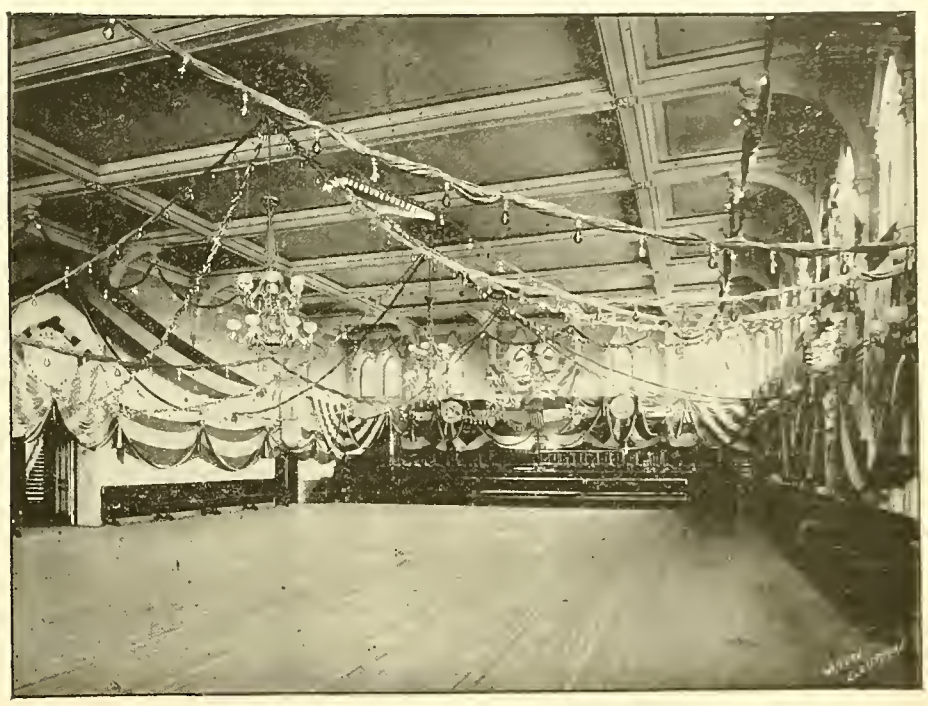
If a workman is careless in making a splice he is liable to leave a wire open, or he may not boil it out thoroughly, and so leave enough moisture there to bring the insulation of the cable very low, and it is difficult to locate such a fault exactly without opening splices until it is found.

Before a splice is started, the cable is tested back to the office, or to the point from which it starts, for open and grounded wires; the length to be spliced on is also tested in the same way, and if any such wires are found they are spliced together, so that although there might be a faulty wire in every section of the cable there would still be only one bad wire from end to end. If the testing were not done, a faulty wire in one section might be spliced to a good wire in the next, and so on; in which case the more sections of cable the more faulty wires there would be in the entire length. After all the splices are made, and the pole or building terminal put on, the wires are tested out and put on corresponding binding posts at each end. A capacity and insulation test is made, and if it is up to the standard the cable is ready for use. At present the insulation must be at least 500 megohms per mile and the capacity at most .08 microfared per mile.

Electrical Decorations in a Ball Room.

Electrical decorations formed the most striking feature of the annual ball of the Massachusetts Electrical Engineers & Mechanics' association, and surpassed anything of the kind ever seen in Boston before. This organization is a very popular one, and is doing good work both as a medium of extending intercourse among the members of the electrical fraternity in the Bay state, and also as an educational institution. The purpose of the ball was to swell the library fund of the association, and the several electrical companies of Boston assisted so heartily that it was enabled to give the public a good object lesson in what can be done with the electric light in the line of decoration. The outside of the building was brilliantly illuminated with scores of arc lights and hundreds of incandescents, with colored globes, mostly in the national colors. Upon the top of the building were placed two search lights, which were directed up and down the streets in the vicinity, and drew a great crowd of spectators.

The ball was the third annual gathering of this association, and the motto as spread before the eyes of all on entering the hall was: "A good time to our members and their friends." Red, white and blue incandescent lamps formed the word "Welcome" at the end of the hall. Just over this was a crescent. At the head of the hall were two



ELECTRICAL DECORATIONS IN A BALL ROOM.

revolving double stars. This was a design of great beauty, and drew forth many expressions of approval. All around the sides of the hall, across the ceiling and up and down the sides of the ball were incandescent globes arranged in many attractice forms. On the platform was a big switchboard which President J. E. Cole manipolated, so that the costumes of the ladies were flooded with alternate blue, red, green, and other colors. A view of the hall showing the main features of the electrical decorations is presented in the cut. Representatives of about all the electrical concerns of Boston and vicinity were present. Among them were: William H. Edgar, D. J. Cartwright, Francis Hilk and William H. Hilk of the Edison Illuminating company; H. C. Cherrington and F. M. Kimball of the General Electric company; G. M. Axford, Charles Gage and B. Cutler of the Boston Electric Light company; James O'Brien and J. J. McConologue of the Edison Light & Power company of San Francisco. Mayor Matthews, Aldermen Flood, Mooney and Maguire, Fire Commissioners Fitch, Innis and Murphy, Inspector of Works Flanders, Chief Abbott of the protective department, and Chief Webber of the fire department were also present as guests. J. E. Cole of the Edison Illuminating company is the president of the association, and much of the hard work to which the success of the ball is due fell upon his shoulders. Mr. Cole is very popular among the members of his profession, and the association under his guidance is one of the most effective organizations of the kind in Boston.

Big Trolley System for the Pennsylvania Coal District.

A big project backed by a syndicate of Philadelphia capitalists was started last week, and a charter was granted for a trolley road, eighty miles in length, by the state department at Harrisburg. The road is called the Northumberland, Bloomsburg & Scranton Street Railway company, and connects thirty-nine towns in that region. Among them are Lackawanna, Pittston, Catawissa, Mechanicsville and Nanticoke. It is a very busy center, and the establishment of a trolley line will materially interfere with the local traffic of the steam roads. At the office of the Reading Railway company it was stated that these roads were generally given the privilege to run over the turnpikes and township roads, thus saving the expense of grading, the largest item of the steam roads' expense in the mountainous country. It was acknowledged that it would make a difference in the revenues of the companies with which the road came in competition. The capital of the new company is $500,000.

Worcester, Mass., will be the center of the largest single suburban system of electric roads in this country provided the present intentions are carried out. The new scheme comprises the joining together of 75 to 80 miles of track under one management, which will constitute a great web connecting the towns surrounding Worcester, and having the latter city as its common center. The Central Massachusetts Street Railway company is the concern which will control and operate the various lines which are to be consolidated.

South Hampton and Kensington citizens are asking the legislature for an electric road to connect Amesbury, South Hampton and Kensington with Exeter, N. H.

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AN item is going the rounds of the press to the effect that the largest isolated lighting plant in the United States is in the Palace Hotel of San Francisco, with 8,000 lamps. This is incorrect. The Auditorium plant now in course of erection in Chicago will supply current to 17,000 lamps, succeeding the old plant of 12,000 lamps capacity. This is believed to be the largest isolated plant in the country.

THE proposition to annex Hawaii has given a new interest to the project of establishing a submarine cable line between Honolulu and California. It is quite probable that annexation would be shortly followed by the laying of such a cable. It would be quite necessary for the government to have means of direct communication with these islands, and an appropriation might be expected from Congress for the building of such a line. But Hawaii has not yet been annexed, and it is not definitely settled that it will be. Yet the present discussion has emphasized the importance of direct communication with that point, and may stimulate enterprise sufficiently to insure the undertaking of this project.

THE death of Dr. Norvin Green will be generally regretted. As president of the Western Union Telegraph company Dr. Green occupied a semi-public position in the eyes of his countrymen for fifteen years. During this time he met the attacks on the great system he represented with ability and tact, and gained many friends. In general Dr. Green's administration was distinguished by conservatism and economy, but he was capable of a bold stroke when necessary. His death is a distinct loss to the Western Union company, as his counsel was valuable and his standing in the community high. In Gen. Eckert, who will probably succeed to the position, however, the company has a man who is well qualified by native ability and long experience to fill the highest place in the gift of the directors.

ACTION was begun in the United States Supreme Court last week by Attorney-general Miller to annul the Berliner patent. In the complaint it is claimed that this patent will, if permitted to stand, perpetuate the monopoly now enjoyed by the Bell company. This company has already enjoyed protection under the fundamental patents granted Bell, and the attorney-general believes that the corporation has received all the privileges that it is entitled to, and that further extension of the monopoly would be opposed to public interest. The fact is recalled that the Berliner patent was not taken out until the Bell patent was about to expire. At the time the Berliner patent was issued there was considerable discussion over the effect it would have upon the telephone business. It was generally conceded that the patent covered fundamental principles, although the specifications and drawings showed a very crude instrument, and one that would not be considered a commercially practical telephone or an improvement on the present transmitter. As a matter of fact the drawings showed an instrument that would not be used in any exchange of the Bell company to-day. These are the grounds upon which the government asks the Supreme Court to annul the patent. The general interest in telephony, which has been aroused by the knowledge that the Bell patent was about to expire, makes the present litigation especially noteworthy. It will be watched with interest by capitalists who are preparing to invest in concerns organized for the manufacture of instruments and equipment of telephone exchanges.

CHICAGO aldermen and others interested in securing as well as dispensing political patronage have been at Springfield during the last week urging the passage of the bills now before the Legislature relating to electric light and telephone service. One of these bills provides for regulating the price of such service and the other confers upon the city council of Chicago the power to extend the city electric lighting plant and engage in commercial as well as public lighting. In short it is proposed to vest the council with power to establish an electric light plant to compete with the corporations now existing and paying taxes into the city treasury. There is no justification for such a measure. It is claimed by the advocates of the measure that cheaper service could be obtained if the city controlled the plants. On what grounds they base this statement is not known. They have published no figures showing the cost per lamp of the present public service, and it is generally believed that they are not in possession of any data that would warrant the statement. If such figures are obtainable they should be presented at once. They would doubtless be read with interest from one end of the country to the other. Then again the taxpayers have a right to know these facts before they place additional power in the hands of their officials. Until the politicians can present statistics proving conclusively that the present city plants are supplying light at a cheaper rate than could be obtained from private enterprises, their petitions for additional powers will be looked upon with suspicion.

A FRENCH contemporary states that 88 central stations were established in France in 1892, and it gives the data of 80 of these plants which are finished. We have tabulated some of the figures and the totals are of interest. First of all it may be noted that many of the plants installed would certainly not be classed as central stations in any list on this side of the Atlantic, though strictly speaking the classification may be entirely correct. For example the central stations at Darnetal, Popian and Presles have each a capacity of 4 horse power; that of Coupy Vanchy 10 horse power; those of four other towns 12 horse power each. There are in the list two stations of 15 horse power, two of 17 horse power, five of 20 horse power, five of 25 horse power, and eight of 30 horse power. The number of dynamos installed in the 80 stations aggregate only 124, and the total capacity of the motive power is but a little over 7,800 horse power. The largest station installed is that at Vienne, which has a total capacity of 600 horse power. More than half the stations are operated by water power, and in 19 stations only is steam used exclusively. Seven of the plants are operated by gas engines; at Beziers two machines of this character of 100 horse power each furish the motive power. In 16 stations accumulators are used; the installation at Cannes includes three batteries of a capacity of 300 ampere hours. It is an interesting fact that in five stations triphase dynamos are operated; these are located at Arbresle, Chambles, Moirans, Salins and Les Ardillats. In the first case the potential is 5,000 volts, in the second 3,000 volts, in the third and fourth 7,900 volts, and in the fifth 8,500 volts.

BOSTON COMMON is threatened with invasion by an electric railway, and the women of the Hub are vigorously protesting against this "desecration" of that historic spot. According to the latest information from the State House the protest of the Boston boys against British interference with their coasting was not to be compared to the present agitation. Our Boston correspondent, in this week's letter, gives the particulars of the scheme for running a line through the Common, by which the trip to the suburbs around Brookline would be shortened by twenty minutes. Business men who have their homes in that locality are favorably impressed by the suggestion and, generally speaking, the business interests of the city support the project. But the women were horrified at the thought, and within two days of the announcement of the proposed line a protest signed by 1,500 women was presented to the Legislature. Mrs. Julia Ward Howe's name headed this list, and it was followed by that of Mrs. Mary Hemenway. Then came an array of women's signatures such as was probably never before presented to the legislature in behalf of any object, and containing the names of the Lowells, the Sears, the Amorys, the Winthrops, the Cabots, the Coolidges, the Paines, the Peabodys, the Bigelows, the Hoopers, the Welds, the Quincys, the Warrens and the Appletons. It is truly a remarkable movement, and one that will be watched with interest throughout the country.

WHILE New York and Philadelphia may not appreciate rapid transit sufficiently to introduce the trolley system on an extensive scale, the progressive and shrewd capitalists of these cities appear to utilize the advantages which it affords and the possibilities in this line for investment. An illustration of this is found in the fact that twelve New York and Philadelphia capitalists have formed a syndicate with John D. Crimmins at its head and have purchased the street railway lines in several prosperous New Jersey cities for the express purpose of establishing an immense electric railway system and adopting the overhead trolley. The lines which this syndicate has already secured will comprise the most extensive electric railway system of the world when the plans of the management are carried out. When the roads passed under the control of the new owners last week there were 140 miles of track comprised in the system. This of itself is certainly a gigantic plant, but it will be greatly enlarged. Connecting lines will be built which will bring the several existing roads into one great system there will be numerous extensions tapping new territory, and new routes connecting these lines with the North River ferries will be laid out. The enthusiasm with which the announcement of the syndicate's plans was received by the people of these New Jersey towns is in striking contrast to the opposition displayed in New York and Philadelphia wherever the trolley was proposed. Mr. Crimmins says that the property owners have petitioned for the immediate equipment of the entire system with electricity, and unusual privileges have been extended with the view of encouraging the new management.

Still another indication of the triumphal progress of the trolley is presented in the almost universal adoption of the overhead system throughout New England. In another column in this issue a review of the work that is being done in that section shows that the electric railways are making rapid strides in public favor. Plans have been perfected for connecting the seaside resorts of New England by electric railroads, and the project has been encouraged by the patrons of these points. The only opposition to the scheme comes from the steam railroad companies with which the proposed electric roads would come in opposition. In the New Hampshire Legislature the representative of one steam railroad appeared before the committee when the question of granting franchises to electric roads was under consideration and strenuously opposed the measure, frankly admitting that the company which he represented could not compete with the electric lines. The power of the steam railroad corporations was exerted against one electric road successfully, and its petition was killed in the committee rooms. This, however, caused such an outcry that it is hardly possible that the experiment will be repeated.

Both of these instances point to a popular awakening to the great advantages of the electric railway from the view point of the capitalist as well as the general public. Time was when both of these forces were arrayed against the trolley.

Norvin Green.

One of the most noteworthy figures in the electrical field has passed away by the death of Dr. Norvin Green, president of the Western Union Telegraph company. This sad event occurred at the family residence in Louisville, Ky., at an early hour on Sunday morning.

The fact that Dr. Green was dangerously ill was not generally known until Saturday evening, when it was said by his physicians that he could hardly live through Sunday. The news of his illness was unexpected, and to the doctor's friends startling, as he had always been a strong, vigorous man, and seemed less liable to illness than most men. Following closely upon the news of his illness came the announcement of his death.

A bowel complaint was the cause of the doctor's death. Since Sunday of last week he had been violently ill. For over a year he had not been in good health. The official duties of his office weighed heavily upon him, and long ago he sought to escape from them, but could not. Again and again he besought the acceptance of his resignation, but the directors would not hear to it, putting it off from year to year.

Norvin Green was born in Floyd county, Ind., on the spot where the city of New Albany now stands, April 17, 1818. He was the son of Joseph and Susan Boll Green, both of whom were of Virginia origin. On the mother's side the family is traced back to the Washington stock. The family removed to Breckenridge county, Kentucky, taking with them young Norvin. The father was elected sheriff of the county after some years of residence. When 14 years of age Norvin kept the books of his father's office. He kept them with as much accuracy as an old man, and while he kept the sheriff's books his county was one of the first to settle with the auditor.

The boy was educated in the country schools and was always a bright and apt student. Before he attained his majority the young man secured a contract to cut cordwood for steamboats in Hunter's bottom, near Madison, Ind. His father had been bankrupted by going surety on a guardian's bond, and was not able to give the young man the medical education he desired. He made enough on his contract, to carry out which he employed a small army of men, to give him a medical education. He secured this at the university of Louisville, graduating in 1840.

Soon after his graduation he married Miss Martha English, a daughter of James W. English, who fought at Tippecanoe and was then a resident of Carroll county. To that county the young doctor and his wife repaired, and until 1853 Dr. Green practiced medicine in Carroll, Oldham and Henry counties.

He served as a representative of Henry county in the Kentucky Legislature from 1849 to 1852. He was a presidential elector in 1852.

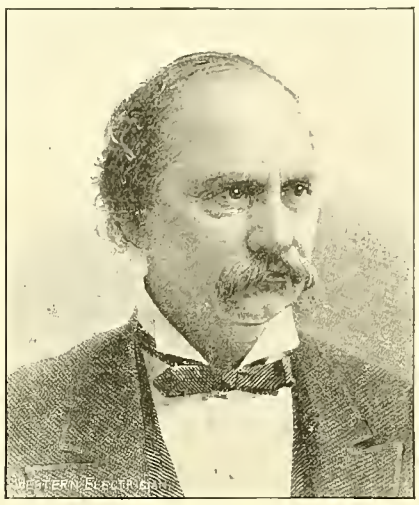
In the following year Dr. Green became interested in the telegraph, a business with which his name has become inseparably associated. In 1853 the condition of the telegraph companies in the country was deplorable indeed. No one ever thought of realizing any profit on the schemes, and Prof. Morse told Dr. Green in later years that the first money he ever received from his invention was a check for dividend money sent him by Dr. Green. Dr. Green displayed his abilities in organizing the shapeless and diverse interests in one paying company.

Soon after the Morse invention two companies were organized, one styled the New Orleans & Ohio Telegraph company, controlled by Dr. Green, and the People's Telegraph company. After a bitter warfare the companies were consolidated. The Southwestern Telegraph company took the field occupied by the two companies under the management of Dr. Green. The work of organizing was pushed until the company became one of the best paying properties in the country. In 1866 the Western Union Telegraph company bought it, making it a part of its systems. Dr. Green engineered that deal and was elected vice-president.

For a few years after this he engaged in railroad matters, becoming president of the Louisville and Cincinnati Short Line. In 1870 this road was sold to a New York syndicate. Dr. Green then went to New York and actively engaged in the affairs of the Western Union Telegraph company. In 1877 William Orton, then president of the company, died, and Dr. Green succeeded him. From 1884 until 1887 Dr. Green served as the first president of the American Institute of Electrical Engineers.

Dr. Green made an excellent president of the Western Union company, and was ever active in the interests of that great corporation. He possessed great executive ability and a judicial mind. In Reid's "Telegraph in America," written several years ago, these personal characteristics are noted: "Dr. Green, though making no pretensions to literary ability, has shown power with the pen. His argument against a proposed act of the national government affecting telegraph companies, as published in the *North American Review*, is a specimen of terse, clear, vigorous English. His mind is practical and he pins his faith on facts. His addresses are invariably informing, and he yields to humor only to confirm his point. The reports of his speeches do not improve their original texture. Few men perform so large a service with so little attrition as Dr. Green. He is not easily disturbed, and is always accessible. His judgment is clear and his humor ready. His mental organization is facile, unexitable and naturally keen and judicial. He is a patient listener, hears all sides, but decides with definiteness and force. As president of the board of directors, nearly all of whom are men of prominence and ability, he never fails to command attention and respect and confidence."

The funeral services are announced for the 16th instant. Nearly all the leading officers of the Western



NORVIN GREEN.

Union Telegraph company will attend, including General Eckert of New York, general manager, and Col. R. C. Clowry, general superintendent, and District Superintendent Tubbs of Chicago.

Cable Project Between Honolulu and California.

The project of laying a cable between Honolulu and this country, which has been long under consideration, is revived by the proposition to annex Hawaii, and the subject is now one of great importance. The situation is clearly presented in the following editorial from the New York *Sun:*

The annexation of Hawaii will presumably be followed at once by the laying of a telegraphic cable from California to Honolulu, a distance of 2,100 miles. The project of running an electric wire across the bed of the Pacific, between America and Asia, has been for many years under consideration. The British have planned a line connecting Australia and New Zealand, by way of the Fijis, Samoa and Hawaii, with British Columbia. An American line would aim to connect San Francisco with China and Japan.

But there have been obstacles to both schemes. One is that with the Atlantic and the Continental lines America already has roundabout telegraphic communication with China and Australia, and a new wire would have to compete with these existing facilities. Another obstacle is the great cost of so long a submarine cable, traversing a route certainly not so favorable as the one furnished by the Atlantic plateau. Several years ago Admiral Belknap's survey showed a trough of extraordinary depth, known to exceed five miles and a quarter, and hitherto resisting all attempts at full sounding, extending along the east coast of Japan, under the Kuro Siwo or Black Stream, from the Kurile Islands southward. In other parts of the Pacific there are known to be very sharp and extreme changes of level along the bottom. The very dotting of the ocean with islands or mountain tops tells the difference between it and the Atlantic.

As to the more restricted project for a cable between the United States and the Sandwich Islands, this, which has also repeatedly been before Congress for authorization and aid, has until now been exposed to the objection that the islands do not yet belong to us, so that no national obligation arises to lay a cable to them, while a purely commercial enterprise for laying it is hampered by the doubt whether there would be business enough to repay it.

With annexation, all such obstacles to a Hawaiian cable might disappear at once. Strategic necessities, current government use of the wire, and the great development of travel and traffic would carry the scheme through. If Great Britain has found it wise to lay a cable from Halifax to Bermuda, with the small population and productive importance of the latter, certainly telegraphic communication would be opened between San Francisco and Hawaii.

But is there a practicable route for such a cable? On this point we have the results of four surveys, made by the Tuscarora, the Albatross and the Thetis. The Tuscarora's exploration, undertaken several years ago, showed very deep depressions and lofty elevations along the route, but it had good points for her successors. It will be remembered that in the Fifty-first Congress the feeling was so strong for uniting Hawaii more closely to this country that the Senate passed by a large majority a bill giving a liberal subsidy to a cable construction company. The House refused to concur in that project, but provided for surveying a cable route to Hawaii at the expense of the government, which might be turned to account at the proper time.

The surveys of the Albatross and the Thetis were made between October, 1891, and May, 1892, that of the Albatross coming first. She began by a run from Cape Flattery to San Diego in search of a starting point, and found it off Salinas pier, Monterey bay, where a soft mud bottom exists. Then a course was run to Honolulu, where the best of four available landings was found about three miles from the port. The return voyage to Monterey bay was on a line several miles to the southward, and while both routes were considered practicable, the latter was the one recommended. The deepest sounding on the outward course was 3,166 fathoms, formed by a large valley that fell 4,000 feet below the surrounding level. The greatest elevation above surrounding levels was 9 500 feet. Near Honolulu the coral formations would require the cable to be encased in steel armor. This is the conclusion reached by Lieutenant Commander Tanner in a lecture delivered about a fortnight ago in San Francisco:

"The existence of a great plateau between the coast of California and the Hawaiian islands seems to have been established beyond question It is shown by the Tuscarora's line from San Francisco to Oahu, and by both of the Albatross' lines. A careful study of the surveys will show a general though moderate rise of the ocean bed in the central regions, without reference to the frequent elevations and submarine mountains encountered."

The Thetis next ran a great circle line of deep sea sounding between Point Conception and Hilo bay. Point Conception is 220 miles south of San Francisco, and 38 from the town of Santa Barbara. From the high ground the water shoals there to a mud bottom. The work of the Thetis was thorough, 341 soundings being taken, and the deepest showed 3,228 fathoms, or 19 368 feet. Hilo is a town of Hawaii, about 200 miles southeast of Honolulu, and its distance from Point Conception is 2,060 miles.

The general conclusion reached by Lieutenant Commander Clover of the Hydrographic Office is that a practicable lane exists on the route to Hawaii, having an average breadth of 300 miles, along which, at various points, are sharp peaks rising abruptly toward the surface of the ocean. The most suitable route is along a mercator line between Monterey bay and Honolulu. This requires a minimum length of cable, while the bottom is chiefly ooze, which is known to be the best for preserving sheathing unimpaired.

These preliminary surveys would presumably be supplemented by others, with the cable once resolved upon, in order to study more closely the shore approaches and the best means of avoiding the lofty peaks and deep holes. But the cable could safely be laid along routes already traced. It will be laid if Hawaii is annexed, and the advantage in distance is all with the American project over one from Victoria.

Trolley Lines for New Jersey.

An extensive street railway deal was consummated last week, by the terms of which 140 miles of street railway lines in New Jersey passed under the control of a syndicate with John D. Crimmins at its head. It is claimed that this is the largest transaction in street railway property that has ever been known in this country. The project includes a plan to connect Newark, Elizabeth, Bloomfield, Montclair and the Oranges with a system of electric roads which will all run to one or more ferry landings on the North River. The deal includes the transfer of the lines of the Jersey City & Bergen Railroad company in Hudson county, which have been leased by the Pennsylvania Railroad company, and the lines leased by the New Jersey Traction company. The first named lease includes, beside the Montgomery street branch, the plank road line which connects Jersey City at Communipaw avenue with Newark, with projected lines to the Oranges. The lease of the Traction company included the Newark Rapid Transit company's and the Newark Traction company's lines. In all there were transferred 90 miles of road operated by horse power, 35 miles operated by electricity, and 15 miles not operated. All of this 140 miles will be operated under one system, all the horse and unoperated lines will be converted into trolley roads, and extensions will be made until every Jersey ferry from Hoboken to Communipaw is connected with the system. It is the avowed intention of the new owners of this extensive system of suburban roads to carry passengers to Newark, Elizabeth, Bloomfield, Montclair and the Oranges as fast as the steam suburban roads, and at no greater fare, running on the principal highways from the ferry landings between and through all of the suburban towns and cities included in the district.

Mr. Crimmins, who is at the head of the syndicate, re

fused to divulge the names of the capitalists interested with him in the deal, but said that the combination was composed of twelve men who resided in New York and Philadelphia. Referring to contemplated improvements and extensions in the service, he said: "We shall adopt the trolley system exclusively. There are only thirty-five miles of trolley in operation now on the roads which comprise the system. Instead of meeting any opposition to the trolley, we are being petitioned to introduce it, and twenty feet right of way in graded and macadamized roads has been offered us. The district is, to a large extent, as much a part of New York, as to its rapid transit requirements, as is the annexed district, and we will endeavor to supply that requirement."

Murat Halstead on the London Underground Electric Railway.

Murat Halstead, in a communication to the *New York Herald*, discusses rapid transit facilities in the great cities of Europe, and contends that the "L" systems of New York and Brooklyn are "unequaled in the world." Of the Greathead tunnel system of London he says: "What of the electrical underground roads like that of London and urged upon New York's attention? Well, they are practicable, but when done they would be certainly inadequate and probably unpopular. They must be very deep, and going down to them is a greater task than ascending the elevated. In order not to disturb foundations and to keep the cost within limits and insure safety the tunnels must not only be far under the pavements, but small. The London electrical cars are narrow and they do not appeal to the million. The descent to the platforms is a journey, the swaying of the cars surprising and the noise shocking. There may be remedies for these afflictions, but the London work seems perfect so far as it goes. The facilities such roads offer are insufficient."

Recording Watt Meter.

The use of the ordinary type of Thomson recording watt meter, under abnormal climate or other conditions, has been restricted, owing to difficulties with which it had to contend. The General Electric company has, therefore, introduced a new type of meter, which has special features to enable it to meet the altered conditions. It is especially designed for service in hot climates, where atmospheric influences are uncongenial, and nephitic gases, damp vapors and minute insects prove detrimental to the ordinary type of recording meter. A glance at the cut will show wherein it differs from the ordinary type. It is a skeleton meter. On the upper side of the lower plate is a groove running completely around it, and into this the cover sets. The groove is filled, after the cover is in place, with heavy oil, gum or cement—preferably a heavy oil. The hole in the base through which the sealing plug of the meter passes, is hermetically sealed by means of a soft rubber washer under the wing nut, while the leading in and leading out holes are closed around the wires by a rubber diaphragm, through which the wires are punched on being entered. These meters are especially useful in such places as chemical factories and dye houses. They are made in all standard sizes up to 150 amperes, and all voltages up to 100 volts, for the two wire system only.

The Name of the Electrical Supply Company Changed to the Ansonia Electric Company.

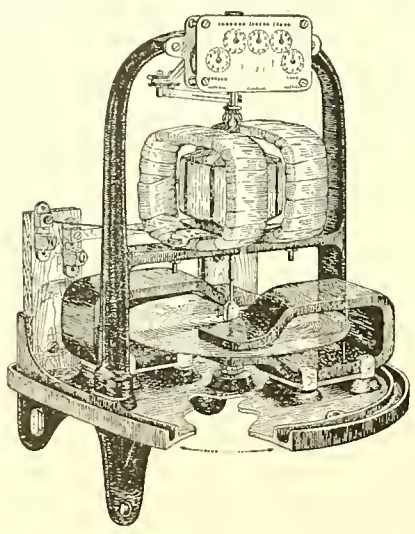
Changing the name of an old established business would seem to the man outside very like swapping horses in midstream, but to those who are acquainted with the facts, and who know, to some extent, the causes that have led up to this step, it will not seem so strange to hereafter know the Electrical Supply company by a new name. Hereafter the organization that has conducted an immense business under that name will be known as the Ansonia Electric company. Some of the reasons for this change of name may be briefly given. While this company was the first to assume the name, incorporating the words "Electrical Supply," it seems that the very nature of the business and the expensive methods that have been employed to make the name known have served also to establish in the mind of the general public an understanding that it was rather a descriptive name, applying to a large class of similar enterprises rather than to one specific organization. So that many times the question might be asked, in determining the source of certain supplies, "Which 'Electrical Supply Company?" Thus, one of the chief reasons for changing the name has been to avoid the use of those two words which have become a misnomer, and then another reason—during the last few years many concerns have been started all over the country calling themselves this or that 'Electrical Supply Company.' While many of these had no thought of appropriating a proprietary name, there have been others who have deliberately sought and intended to profit by the popularity of it. This certainly has been the cause of considerable annoyance to the originators of the name.

Statistics show that of the numerous electrical supply firms started during the last ten years more than 90 per cent. have failed or otherwise gone out of business. These various little concerns, in many known instances, fostered the belief in their locality that they were related in some way to the large manufacturing company of the same name, and when these little fellows folded their tents and the sheriff came and took possession of the "grub stakes," it left a bad impression, and while it, perhaps, did no particular damage to, yet it reflected no particular glory upon, the original company, that did not even know of their existence. Various circumstances of this kind might be quoted as reasons why the managers of the Electrical Supply company finally determined that perhaps it would be best to make a change in the name. Nothing else but a change of name was contemplated, and no other changes have been made whatever, either in the organization or the personnel of the company.

Under the wise management of its two divisions, the one embracing the factories at Ansonia, the other the salesrooms and warehouses in Chicago, the business has grown to very large proportions. Extensive improvements and additions to the several factories in Ansonia have been planned and partly consummated, and all in all it has seemed a provident and wise thing to assume a name about which there could never arise a doubt or dispute as to its rightful and singular ownership.

There is no name in the United States more familiar to the electrical world than that of Ansonia. It is known quite as well as New York, Boston, Detroit, Minneapolis, Omaha, New Orleans, San Francisco or Chicago, although perhaps not so commonly talked of as Chicago at the present time.

In the minds of the pioneer electrical men Ansonia will always hold a warm place, for many of the men who are



RECORDING WATT METER.

prominent in the development of the sciences have made pilgrimages to Ansonia in the quest of information, or to confer with the man, William Wallace, to whom can be traced the first practical ideas of the commercial advantages of electric lighting. In Ansonia the first dynamo in this country was built. It was in Ansonia that the electric light was first used commercially; it was there that Mr. Edison first saw the electric light, and from there that he got the machine with which to conduct his first experiments. It was an Ansonia built machine that was exhibited at the Centennial Exposition, and furnished the only electric light that was shown at that great exhibition.

It was this same machine that Charles Brush spent a great deal of time examining, and from which he derived some of his most valuable ideas. This machine is still in existence, and will no doubt form one of the most interesting features of the exhibit to be made at the World's Fair by the Ansonia Electric company. It might also be of interest to note that at Ansonia the first electric light carbons were made, but at that time they were made in the form of thin slabs, or square sticks, instead of the round carbon which is used to-day. It was Mr. Wallace also who conceived the idea of giving the carbons a coating of copper to increase the conductivity.

This town of Ansonia, Conn., is, and always will be, in the minds of the older electrical people associated with the early days, and the rise and development of a new and great industry, and this association or relationship is in a fair way to be perpetuated and handed down through the generation of younger men who are fast filling the ranks of the great army of electrical workers.

The name of the Ansonia Electric company is, therefore, one that will, in every way, very properly represent and fit the company that had its start in Ansonia, and was established by the man and his sons who have been so thoroughly and clearly the pioneers in the business.

"Why is it that telegraph companies cannot send out notifications of money orders received by telegraph on the same kind of paper that ordinary messages are sent?" is a query propounded by a Rochester, N. Y., merchant. He continued: "At present a notification of money received is sent out on a thin tissue paper sheet. Any one in your office knows when you receive a telegraph money order by feeling of the envelope. Now, you know, it often happens that you do not care to have everybody know when you receive money by telegraph. They can't escape such knowledge by the present system."

CORRESPONDENCE.

New York Notes.

NEW YORK, February 11.—As predicted in the WESTERN ELECTRICIAN two weeks ago, the legislative investigation of the Rapid Transit commission, which was proposed by Assemblyman Malby of St. Lawrence, will not take place. The assembly has passed a vote of confidence in the commissioners, and the subject has been disposed of. Hamilton Fish, a republican, denounced the resolution providing for the appointment of a committee. He said that he did not believe that such men as William Steinway and John H. Starin should be subjected to an investigation. They were men whose characters were of too fine a grade to be smirched by an irresponsible assailant.

The Rapid Transit commissioners are giving careful and deliberate consideration to the several communications and propositions submitted to them by the committee of the Manhattan Elevated Railroad company for the extension and improvement of the existing elevated system to meet the popular demand for increased rapid transit facilities.

An informal conference of the sub-committee of the Citizens' Rapid Transit committee was held this week to consider the details of the amended bill Assemblyman Farquhar is to introduce at Albany. Mr. Farquhar's original bill legislating the present Rapid Transit commissioners out of office and providing for the creation of a new board was unsatisfactory to the Citizens' committee because it made no provision that the city might undertake the building of the road at the public expense in case private capital sufficient to undertake the work could not be secured. This committee is committed to the plan of having an underground road, substantially as planned by the present commission and, if necessary, desires that the city should build and own it. Assemblyman Farquhar is now in full accord with the committee on this point, and will amend his bill accordingly. The committee prefers that the road shall be built by private enterprise and is only anxious to procure legislative authority for the city to build it in case private enterprise does not come to the front.

P. Kingston has submitted a scheme which he thinks will effectually solve the rapid transit problem. He proposes that every building now in the city hall park be removed to make room for a grand central rapid transit station, into which all routes should lead and from which all lines should radiate. From this central station he would construct three tunnels, one with four tracks down Broadway to Bowling Green or South ferry, the second with a double track through City Hall place, Pearl street and Park row to East Broadway, to Rutgers street, to Essex street, where the tunnel would end; the third, also, for a double track road to run under Broadway to Warren street, thence to Washington street, where it would end. The east side route he would continue by an elevated road through Essex street and avenue A to Twenty-third street, then diagonally across private property, to be condemned, to Twenty-fifth street and First avenue and up the latter to and across the Harlem river, to connect with the steam, surface and elevated roads now in operation in the annexed district. The west side route he would continue by a similar elevated structure through Washington to Little West Twelfth street, thence diagonally across private property, to be condemned, to Fourteenth street and Tenth avenue, continuing up the latter to Dyckman street, to be extended further as required.

The tunnels, Mr. Kingston explains, are proposed as a means for crossing existing lines, and also to avoid trespassing upon already overcrowded streets. The elevated roads he would operate with smokeless steam locomotives or electricity. He also suggests an upper roadbed, double tracked, for express trains. These two systems he would connect at intervals of one mile by crosstown roads of similar construction. The East River Bridge Mr. Kingston would have extended into his grand central station in the park.

James J. Kiernan, a policeman who on March 21, 1891, was injured by a live wire belonging to the Metropolitan Telephone & Telegraph company has an action for $5,000 damages against the company which is now on trial in the Superior Court before Judge McAdam and a jury. The day in question was a stormy one, and it is claimed that the wire was not properly secured. Kiernan was sent to the place to protect passers by and the wire struck him, burning him about the hands and body so severely that he was prevented from attending to his duties for six weeks.

Judge Bartlett handed down a decision in the Supreme Court, Brooklyn, Thursday, which will enable the local railroad companies to extend their electric trolley wires

across the plaza at the main entrance to Prospect Park. Commissioner Brower refused to grant a permit to the Brooklyn City Railroad company to string its wires over this open space, and the company applied for an injunction to restrain the commissioners from interfering, basing the application on the fact that a franchise had been obtained from the aldermen. Judge Bartlett grants the injunction, and in his opinion says that the question is not whether the trolley is dangerous or not, but whether the park commission has control over the plaza. He decides that no such power exists, and adds that the power of the commission is subordinate to that of the Common Council, which has passed an ordinance granting the right to string wires across the plaza.

The people of this city know absolutely nothing about the trolley system, yet they condemn it, and thereby not only deprive themselves of the advantages of rapid transit, but by their constant howling against it, demonstrate their ignorance and hold the city up to ridicule the world over. Commenting upon this exhibition of mendacity, the Salem, Mass., *Gazette* remarks: "The determined opposition to the trolley system shown in New York, Brooklyn, Philadelphia, Baltimore and other of the large cities of the country seem strange to people in this vicinity. To read the discussions in the legislative chambers of those places, and the editorials in the leading papers there, one would think that some frightful monster was about to be let loose upon them. People at all familiar with its workings know that these evils and dangers exist almost wholly in the distempered fancy of those not well informed in the matter. As we write, we can recall no single fatality directly traceable to this source. The fires supposed to spring from it are nearly as imaginative. It is, as yet, the only practicable method of electrical propulsion. And despite the vigorous opposition made, it is gaining a foothold in nearly all these cities. Once in full operation there, all will see that in delaying its introduction they have been standing in their own light."

The principle of transmitting outline pictures by telegraph has been ingeniously applied to the illustration of foot-ball matches in newspaper reports. A New York paper recently supplemented its report of a foothall game by charts on which the course of the ball was shown at certain points of the contest by an apparent tangle of lines. The method of telegraphing these charts is quite simple and perfectly accurate. The original chart is made by the reporter, who stands on the field of action. He has in front of him a sheet of paper divided into very small squares, and from the center of the sheet he starts his pencil in directions corresponding with the flight of the ball. Every change of direction in the course of the ball, either through the air or when it is carried by hand, is minutely recorded by the lines on the original chart, and in order to show when it was kicked and when it was carried broken and solid lines are used. After the game is finished, the story told by the chart is prepared for the telegraph wires. At the end of every vertical and horizontal line on the chart is an English word of three letters, and if any word is taken on each of the two sides and the two corresponding lines are followed to their junction, the two words selected will represent the point where the two lines meet and no other. In this way all the points on the chart representing the change of direction in the ball's course can be translated into a code, and in this form is telegraphed to its destination. At the office of the newspaper receiving the message, is a sheet of cross-lined paper exactly similar to that used by the reporter on the field. The first two words of the telegram are taken and the junction of the lines represented by them is found and marked with the point of a pencil. The next two words are similarly followed out and the junction point of their lines marked. These two pencil marks are then joined by a straight line, which shows the direction of the ball from the starting point to the first deflecting point. The whole dispatch is translated in this way, and the result is an exact reproduction of the original chart.

In connection with the recent attempts upon the life of the Russian czar, the *Herald* of this city calls attention to the fact that Leo Hartmann, the man chosen by the terrorist party to make the first attempt on the life of Alexander II., is living in the city and is working at his trade as an electrician here.

Charles P. Friend, a dry goods merchant of Jersey City and a director in the Jersey City Electric Light company, died last week.

Northwestern Notations.

MINNEAPOLIS, February 11.—The present legislature has evinced a disposition to meddle with electric question, and at the present time there are several bills pending—good, bad and indifferent. One is a bill providing for a new state officer, an examiner of telegraphs, at a salary of $1,500. An assistant at $1,200 is also provided for. The officer is to examine applicants for positions as telegraphers and train dispatchers, inspect instruments, etc. Licenses of two grades are provided for, and companies are to be compelled to employ none but licensed operators. There is also some telephone legislation pending. A bill limiting the charge for a telephone to $3 per month has been introduced, and the committee had a hearing the other night. A St. Paul attorney appeared for the Northwestern Telephone company and argued forcibly against the proposed measure. He held that the company could not continue in business at the rates fixed. Mr. O'Brien submitted some figures which are interesting and important enough to reproduce. They are for the business of 1892:

Minneapolis Exchange—	
Gross earnings	$[illegible]
Gross expenses	[illegible]
Net earnings	$[illegible]
St. Paul Exchange—	
Net earnings	$1,110 79
Exchanges outside—	
Faribault, net loss	$315 27
Northfield, net loss	438 37
Mankato, net profit	[illegible]
St. Cloud, net profit	477 05
Winona, net profit	[illegible]
Stillwater, net profit	854 10

The net result for the state outside of Minneapolis and St. Paul is:

Net earnings	$[illegible]
Net earnings for the whole state	$8,915 42

The following comparative showing of minimum rates was given by cities per year:

	Business office.	Residence.
New York	$150	$100
Boston	120	96
Philadelphia	120	100
Pittsburg	120	84
Baltimore	100	72
Brooklyn	100	75
New Orleans	100	75
Milwaukee	100	72
Cleveland	72	60
Kansas City	72	60
Minneapolis	60	48
St. Paul	60	48

A Minneapolis attorney added his plea in behalf of the company in a similar strain. He claimed that all profits had been spent on improvements. C. P. Wainman, general superintendent of the company, gave some additional facts about the business. He said that the profits had been 2 per cent. on the capital stock. A representative of the Duluth exchange said that the bill would practically ruin that company. The committee did not take any action. It is not very likely the bill will go through.

A syndicate claiming to have ample capital wants to have a chance at the street railway business of Duluth. It will ask for a franchise, promising to pay regular revenue to the city. It will guarantee five miles in operation within six months of getting the franchise. The names of the projectors have not been made public.

As the outcome of recent negotiations and combinations the Edison Building company has just been incorporated in Minneapolis. The capital stock is $130,000, and the incorporators are S. G. Cook, C. H. Maxcy, J. S. Porteous, J. M. Totten and J. P. Holdridge. The company will own and operate the big ten-story building back of the Lumber Exchange, with its elaborate electrical equipment.

Up on top the hill at Duluth the population has been fast increasing since the car line was run up the hill. The people are now clamoring loudly for an extension of the electric light service to their mountain homes.

West Duluth is putting in a complete fire alarm system.

Charles Waite, W. G. Rice, P. L. Gibbs, B. F. Ankeny and John Dickson are directors of the new Spearfish, S. D., Electric Light, Heat & Power company. Mr. Waite is president and has gone on a tour of investigation of other plants. The station is to be built on Spearfish creek, three miles above the town, where 3,000 horse power is available.

Banker Page of Minot, N. D., proposes to form a stock company and put in an electric light plant.

At a citizens' meeting at Devil's Lake, N. D., $15,000 of the $50,000 needed for the electric light and street railway plant was raised. The project will be pushed at once and a franchise secured.

The National Electric works at Eau Claire, Wis., are so crowded with work that it is probable that they will soon be enlarged.

B. F. Meek, Jr., formerly secretary, has been promoted to the vice-presidency of the Northwest General Electric company.

The council at Sauk Center, Minn., has closed a contract with the Central Minnesota roller mills to furnish power to operate the electric light plant for five years.

Chamberlain, S. D., is going to have electric lights.

The Enamel Insulator company has asked for an injunction restraining the Carpenter-Nevins Electro Heating company from disposing of its interest in a certain process of insulation or beginning suits in equity against the complainant. H. C. C.

New England Notes.

BOSTON, February 11.—Rapid transit, municipal lighting and underground wires are receiving more consideration than any other three subjects which have to do with the city's welfare to-day. There is no division of opinion on the question of Boston's great need of better means of getting about the streets, but there is great difference of opinion regarding the way this is to be achieved. President Whitney of the West End Street Railway company has submitted a proposition to use a portion of the Common, either a strip along Tremont and Boylston streets or a straight cut through it from Park street to Park square. Strange as it may seem this proposition does not excite the holy horror that it would a few years ago. Leading citizens, men who have had much to do with the business development of the city, support Mr. Whitney's position. Years ago when the Common was the only breathing spot the city had, its value could not be overestimated, but now that a comprehensive system of parks has been created which gives the city four times as great a free area as it had when it had to depend on the Common alone, there seems to be less reason in the minds of many for regarding it as a spot that is only to be spoken of reverently and not passed without bending the knee. It is proposed to run express cars across it, and this would save about twenty minutes in the now exasperatingly slow trip from the heart of the city to the suburbs around Brookline. Of course there is strong opposition in certain quarters to such a movement, but it is losing ground, and it is sure that the time is not far distant when Boston Common will be utilized for street cars, if nothing more.

The citizens of Roxbury have introduced a scheme for an elevated railway. The plan briefly is to cover the city and suburbs. It authorizes the aldermen to lay out routes not exceeding thirty miles in length of double track. Tracks must be capable of holding a train of five cars with 48 passengers in each. The structures and stations in the streets shall become the property of the city on erection. Motors must be able to start or stop within two train lengths when running at a rate of 15 miles an hour. There are to be four motors and 16 cars to each mile of road. Fares in Boston are not to exceed five cents.

Mayor Matthews asserts that the city pays altogether too much for its gas, and has sent a petition to the Legislature for an enabling act to permit the city to manufacture gas or electric lights as it shall deem best. He also favors legislation that will compel all gas and electric light companies to pay to the city a tax at the general rate for the year upon all notes, bonds or other obligations owed by such corporations, and compelling the companies to furnish gas or electric lights to the city at the cost of manufacture. The city council has taken this matter up, and has appointed a committee to consider the advisability of the city maintaining and operating gas and electric light plants.

Inspector of Wires Flanders and other officials of the city, the fire department and insurance underwriters are before the Legislature asking that all electric wires in the city except trolley wires shall be put under ground. The report of the fire marshal on the Federal street fire is that while the mass of wires at this place did not materially retard placing the fire under subjection in this instance, the wires are liable to prove a serious and dangerous hindrance to the firemen.

Chief Electrical Engineer F. S. Pearson of the West End Street Railway company has resigned his position to accept the general managership of the new coal combine which he and President Whitney have engineered in Nova Scotia. The work of construction for which Mr. Pearson was secured is now practically completed, and his office will be abolished, the electrical supervision of the West End road being divided between several of the present officials of the road.

The annual report of the gas and electric light commissioners of Massachusetts, just presented to the Legislature, shows considerable progress in municipal lighting. There are now 135 companies, towns and individuals in the state engaged in supplying light for public use. Of these, twenty-six supply both gas and electricity, and sixty-two electricity, against forty supplying gas alone. New electric light companies have been established during the year at Worcester, Hull, Natick and Boston. Four municipalities have established municipal lighting plants under the new statute. They are Danvers, Braintree, Peabody, and Wellesley. East Bridgewater, Needham, Stoughton, Winchester, Woburn, Springfield and (since the report was issued), Boston, have taken some action toward this end

During the year seven persons were injured by electricity, four of them fatally, against twenty four accidents from illuminating gas.

The State Central Railway company, the concern which proposes to build a network of electric roads around the heart of the commonwealth, proposes to increase its capital stock from $450,000 to $650,000.

The Worcester Traction company has made the final payment of $1,400,000 for the purchase of the Consolidated street railway of Worcester. The board of directors is now as follows: Hon. C. B. Pratt, Col. A. G. Bullock and F. H. Dewey, of Worcester; E. J. Moore, of Philadelphia, and T. C. Barr, of Newark, N. J. A contract has been let for the construction of a car house on Market street, to hold 150 electric cars.

The employes of the Lowell Suburban Street Railway company have had their pay increased from 16 to 18 cents an hour and their day's work decreased from 12½ to 11 hours.

The Manchester, N.H., Electric Light company has elected the following named officers: President, Alonzo Elliott; vice-president, James A. Weston; clerk, J. W. Hildreth; treasurer, Walter G. Africa; superintendent, J. B. Smith; directors (in addition to the above), Frank Dowse, J. C. Moore, George F. Lincoln, Harry E. Parker and John B. Varick. The receipts of the company have increased $4,628.37 over the preceding year, and 40 miles of wire has been added, making a total of 150 miles in use. The stockholders voted an increase of $250,000 in the capital.

At the annual meeting of the New England Telephone company held at New Haven, these directors were elected. Morris F. Tyler, Lyman B. Jewell, A. H. Robertson, Wm. E. Downes, A. W. Jillson, James English, A. O. Morgan, Samuel E. Merwin and Thomas Sherman.

The electric power station at Merrimac for the Haverhill, Amesbury & Merrimac, Mass., electric road has been put in operation.

The capitalists interested in the projected Mystic Valley street railway have elected a temporary board of directors as follows: A. L. Wyman, Winchester; G. E. Smith, Boston; H. C. Buck, New Brighton, Staten Island; J. B. Humphrey, Somerville; S. W. McCall, Winchester; G. S. Littlefield, Winchester; D. N. Skillings, Winchester. These gentlemen are representative business men. Mr. McCall is a congressman-elect, and Mr. Buck has been interested in the formation of many electrical enterprises about Boston, notably the Somerville and Malden electric light companies. The length of the proposed road is six miles and it will be capitalized at $60,000. The route is from Central square, Stoneham, through Winchester and Arlington.

The Rockport Electric Street Railway company has asked for papers of incorporation.

Boston capitalists are having a route surveyed for an electric road to run through the heart of the Pawtuxet valley in Rhode Island. It will pass through ten large villages.

The rush for electric road franchises is so great in Connecticut that the Legislature is considering a bill providing for the creation of a street railway commission, to consist of a lawyer, an electrical engineer and a practical business man.

In a recent test in the yard of the General Electric company at Lynn, an electric locomotive was coupled to a big Boston and Maine railroad steam locomotive, and the electric had the best of the tug.

The Narragansett Electric Light company of Providence has secured control of the Union Street railway, of that city, and will operate it with power from its station.

The American Electrical Works of Providence have bought the plant of the Richmond Paper company, and will use the property for the extension of the insulated electric wire manufactory.

An electric road between Athol and Orange, Mass., is to be built by a syndicate which is before the Legislature asking for a charter. It will be capitalized at $100,000.

The General Electric company will change all the circuits of the Haverhill, Mass., Electric Light company over from 110 and 220 volts to 500 volts.

The new directors of the Merrimac Valley Street Railway company have re-elected N. E. Morton superintendent.

The Boston underwriters are to have a series of tests to ascertain if the standard of insulation they determined upon in 1889 is being maintained. The tests already made show that while certain grades of insulation are all right for the low potential to which they are subjected in incandescent lighting they are liable to be broken down by the potential on motor circuits under a pressure of 500 volts.

The Malden Smokeless Boiler company has been incorporated at Portland Me., with a capital of $150,000.

The town of Brookline is wrestling with the induction problem in connection with its telephone service. Many complaints are received from subscribers on account of the disturbance caused by adjacent electric light wires. A hearing was held recently at which both the telephone company and the electric light people were represented, and the latter said that they were experimenting with hopes of finding some way to prevent the trouble. The hearing was adjourned to allow them time to finish the experiments.

There are forty-one applications for franchises for electric roads to be brought before the Connecticut legislature this winter.

Efforts are being made by the East Side association of Melrose to induce either the Eastern Middlesex road or the Wakefield and Stoneham road to extend a line throughout the eastern part of Melrose to accommodate that rapidly growing section. The line is wanted to extend from the Highlands to Maplewood, and it would be operated by electricity.

The Quincy & Boston asks the railroad commissioners for a new location for a line to connect the Dover & Milton branch of the Old Colony to the street railway company's line at Neponset river.

A meeting was held at Rockport, recently in the interests of an electric road from Rockport to Pigeon Cove. This is the fashionable residential portion of Cape Ann, and sufficient stock has been subscribed to warrant the construction of the road. It will be for freight as well as passenger traffic and will accommodate the big granite quarries of that section.

The big new grain elevator of the Boston & Maine railroad on Mystic wharf, Boston, is to be lighted by electricity from its own plant. This elevator has a capacity more than equaling all the other elevators in Boston. Incandescent lights will be used in the building, while the surrounding grounds will be illuminated by arc lights. Apparatus for 850 incandescents and 50 arcs will soon be in place.

The Norfolk Suburban Street Railway company, a new corporation, has sold all its stock. The company will now set about building a road from Dedham Centre through Hyde Park to the Mattapan railroad station.

A company is now being organized for the purpose of constructing an electric road from Mt. Auburn, Cambridge, to Arlington. The proposed road is to be about 4½ miles long, and application for a location is to be made inside of a month. There is at present no means of communication between the proposed termini.

Two roads which are soon to be built will give Boston direct electric communication with South Framingham, a distance of 18 miles. One of these links will connect South Natick and Wellesley Falls, and the other will be a branch from West Newton to Wellesley Falls.

The Garden City Railroad company which was given a franchise to build a storage battery road from Newtonville to Newton Centre has given up the contract, saying that the storage battery system is a failure. A new company was formed and this corporation now asks for a charter to build a road from Newton Centre to Brighton, thus making three lines from Boston to Newton. The Newton Railway company is also to build a trolley line between Waltham and Watertown. When this and other proposed roads are completed this section of the suburbs of Boston will have the most complete system of electric roads of any portion of the country.

A company has been organized under the name of the Dartmouth & Westport Street Railway company, which will build an electric road to New Bedford and Fall River if they can get permission of the railroad commissioners. The members of this company are mostly interested in the existing Union Street Railway company of New Bedford and the Globe Railway company of Fall River.

The Mather company has secured a contract for two 600 light dynamos to light the Hathaway cotton mills of New Bedford.

The Lynn & Boston Railway company has a new power house almost completed in Chelsea.

The Boston City Council has passed an order requesting the city engineer to investigate and report concerning the ability of the bridges of the city to bear safely the large street cars now in use, and to obtain from the corporation counsel his opinion regarding the liability of the city in case of any damage to the bridges through over weight.

The Brown Electric company of Boston has received a charter from the secretary of state. The capital is $10,000, and the officers are Chas. F. Snedeker and John M. Oxford.

The New England Telephone & Telegraph company is putting a new metallic circuit between Boston and Portland for the use of brokers at connecting points along the line which will be 225 miles long.

A Brooklyn syndicate has bought the property of the Manchester Street Railway company of Manchester, N. H. Gen. Chas. Williams was the owner and he has been fighting a movement on the part of the citizens to get him to adopt electricity as a motive power. It is said the new owners will introduce this at once.

The Boston city government has voted to pay each of the members of last year's rapid transit commission $2,500. They were chosen to serve without salary.

E. W. Countis, manager of the Enfield, N. H., Electric Light company has resigned this position to go to Portsmouth, Va., where he will be manager of the electric plant at the Norfolk navy yard. E. B. Far will succeed him at Enfield.

J. N. Akerman has been made manager of the Consolidated Street Railway company, of Worcester. He was formerly with the West End of Boston.

The property of the West End Street Railway company is insured for $3,500,000.

The Woburn board of trade is soon to hear a proposition for the construction of an electric road to Lowell. Lowell authorities are already interested in the matter. The distance between the two cities is sixteen miles, and the route would be directly to Billerica and Burlington. It could connect with the North Woburn line, which runs to Winchester and Medford. If put through, it would furnish electric conveyance from Boston to Lowell by way of the present line to Winchester. This is a distance of 30 miles.

The Taunton Electric Light company has contracted for three new boilers and a 200 horse power engine. This addition to its facilities will give it a capacity of 5,000 incandescent and 300 arc lights.

Another electric freight road will soon be in operation in Maine. It will connect Sanford and Springvale, and will use split switches and railroad frogs. It is three miles long, and is intended to handle freight for the mills at Sanford.

J. C. E.

NEW INCORPORATIONS.

New York Electrical Works, New York, N. Y.; capital stock, $50,000; to manufacture and sell electrical instruments and appliances.

Columbia Water & Light company, Columbia, Mo.; capital stock, $80,000; operating electric light, water and gas works; R. B. Price, Columbia, Mo.

Chicago & Southwestern Electric Railway company, Chicago, Ill.; capital stock, $100,000; to operate an electric railway; B. F. Jacobs, Chicago, Ill.

Fairbury Electric Light, Heat & Power company, Fairbury, Ill.; capital stock, $12,000; to furnish electric light, heat and power; Henry A. Foster, Pontiac, Ill.

Cleburne Light, Ice & Oil company, Cleburne, Tex.; capital stock, $75,000; to supply light, heat and electric motive power, etc; John W. Floore, Cleburne, Tex.

Mt. Carmel Light & Water company, Chicago, Ill; capital stock, $50,000; electric light, power and water plant; W. S. Reed & Co., 517 Rookery building, Chicago, Ill.

Ridgewood Electric Light & Power company, Ridgewood, N. J.; capital stock, $20,000; to furnish electricity for light, heat and power, etc.; Cornelius Doremus, Ridgewood, N. J.

Austin Engineering company, Chicago, Ill.; capital stock, $100,000; to build, operate and superintend steam and electric plants; Lucius Weinshenk, 184 Dearborn street, Chicago, Ill.

Catasauqua Electric Light & Power company, Catasauqua, Pa.; capital stock, $60,000; supplying light, heat and power by electricity to the public in Catasauqua; Austin A. Glick, Catasauqua, Pa.

Lewisburg & Mifflinburgh Electric Railway company, Lewisburg, Pa.; capital stock, $100,000; constructing and operating an electric railway in Union county, Pa.; B. K. Focht, Lewisburg, Pa.

Ocean City Electric Light company, Ocean City, N. J.; capital stock, $30,000; supplying the borough of Ocean city and the inhabitants thereof with electricity for light and heat purposes, etc.; E. B. Lake, Ocean City, N. J.

Middletown Electric Power & Railway company, Middletown, Ohio; capital stock, $100,000; operating electric street railway, furnishing electric power, etc.; W. H. Todhunter, Middletown, Ohio.

Merion Avenue Passenger Railway company, Philadelphia, Pa.; capital stock, $50,000; constructing and operating an electric railway in Philadelphia, Pa.; J. Clayton Erb, 1326 Chestnut street, Philadelphia, Pa.

Jackson & Porter Street Railway company, Philadelphia, Pa; capital stock, $50,000; constructing and operating an electric railway in Philadelphia, Pa; J. Clayton Erb, 1326 Chestnut street, Philadelphia, Pa.

Northumberland, Bloomsburg & Scranton Street Railway company, Northumberland, Pa.; capital stock, $500,000 constructing and operating an electric railway in Northum

berland, Montown, Luzerne and Lackawanna counties, Pa.; J. R. Coyle, Shenandoah, Pa.

Shamokin & Elysburg Electric Railway company, Shamokin, Pa.; capital stock, $100,000; constructing and operating an electric railway in Northumberland county, Pa.; C. M. Clement, Sunbury, Pa.

Citizens' Electric Light, Heat & Power company, Lancaster, Pa.; capital stock, $100,000; supplying light, heat and power by electricity to the public and the city of Lancaster, etc.; Chas. H. Locker, Lancaster, Pa.

Birdsborough Street Railway company, Wilkesbarre, Pa.; capital stock, $12,000; constructing and operating an electric railway from Birdsborough to Baumstown, in Berks county, Pa.; G. Mortimer Lewis, Wilkesbarre, Pa.

Belmont Avenue Railway company, Philadelphia, Pa.; capital stock, $18,000; constructing and operating an electric railway in Philadelphia and Montgomery counties, Pa.; John S. Gerhard, 251 South Fourth street, Philadelphia, Pa.

Ocean City Electric Railroad company, Ocean City, N. J.; capital stock, $100,000; supplying the borough of Ocean City and the inhabitants thereof with electricity for street railroad purposes, etc.; E. B. Lake, Ocean City, N. J.

Elliott Electric company, Cleveland, O.; capital stock, $35,000; manufacturing, repairing and dealing in all kinds of electrical machinery and appliances, supplying electricity for all purposes, etc.; Francis C. McMillin, Cleveland, O.

Central Electric Heating company, Jersey City, N, J.; capital stock, $750,000; to produce, use, distribute, regulate, control or apply electricity or electrical apparatus for the purpose of heat and power, etc.; Alexander & Green, New York, N. Y.

Edison Building company, Minneapolis, Minn.; capital stock, $130,000; to buy and sell real estate, run and operate buildings, manufacture, produce and transmit electric light, steam, heat and power; S. G. Cook & Co., Lumber Exchange, Minneapolis, Minn.

Alton Electric Street Railroad company, Alton, Ill.; capital stock, $250,000; to build and operate street railroads through Alton, Upper Alton, North Alton, Godfrey township and suburbs, also electric light and power plants, etc.; Manning Mayfield, Alton, Ill.

LEGAL DECISIONS.

An allegation in a petition that a message was delivered to a telegraph company, which received the message and delivered it, shows an implied contract between the sender of the message and the connecting company. The person for whose benefit a telegram is sent, though not a party to the contract, may sue the telegraph company for loss occasioned by a delay in delivering such telegram.—Martin v. W. U. Tel. Co. Court of appeals of Texas. 20 S. W. Rep. 860.

A city passenger railway company was leased for a term of years, and operated and managed exclusively by its lessee company, which had all the powers and authority of the lessor, except the sole reserved franchise to be a corporation, and in addition had its own express franchise, to make contracts and lease and operate roads, and furnish motive power. By city ordinance the city lessor company was authorized to construct the necessary appliances for the overhead electric system. The lessee company was organized at a later date with charter power to use the overhead system with consent of the council. The court held that, though the ordinance named only the lessor company, the lessee company had as full power thereunder as if it also had been named therein. Reeves v. Continental R'y Co. Sup. Ct. of Penn. 25 At. Rep. 516.

ELECTRIC LIGHTING.

B. T. Delafield will erect an electric light plant in Marion, Ind.

An interesting application of electric lighting has recently been carried out by the Northern Railway company of France. The passenger coaches of this company are now lighted by means of electricity, the current being stored in accumulators placed under the seats. First class carriages are fitted with a 10 candle power lamp; second class carriages with an 8 candle power lamp, and third class carriages with a 6 candle power lamp. In each carriage a battery of 16 Laurent-Cely accumulators is placed, having a capacity of 115 ampere hours. It is estimated that, as compared with oil lighting, there is a slight saving in favor of electricity.

The Allentown, Pa., Electric Light & Power company has accepted the proposition from the Industrial Improvement company, which has the controlling stock in the Allentown & Bethlehem Rapid Transit company, by the acceptance of which the electric light company passes into the hands and control of the Industrial Improvement company. The proposition in question was virtually that the Allentown Electric Light & Power company issue $150,000 of preferred stock, bearing 7 per cent. dividends per annum clear of taxes; $50,000 of this stock is to be taken at par by the Industrial Improvement company and the proceeds applied to the payment of the mortgage boods and other indebtedness of the electric light company and the improvement of its present lines. The other $100,000 of the preferred stock is to go to present local holders of the electric light company stock in exchange for their present holdings of common stock, if they desire to make the exchange. The $100 000 of common stock now owned by the local holders is to go to the Industrial Improvement company, which will thus control the electric light company. This $100,000 is to be expended in the erection of a new plant.

ELECTRIC RAILWAYS.

The Northwest General Electric company proposes to build an electric road in Eugene, Ore.

A franchise for the construction of about twenty-five miles of electric street railway has been granted to the Alamo Electric Street Railway company of San Antonio, Tex.

The organization of the Alton, Ill., Electric Street Railroad company has been perfected. The stock of the company, $250,000, is all subscribed and held by the following named gentlemen: J. G. White, J. H. Porter, George H. Walbridge and A. M. Farnum of New York, and F. H. Harrison of Boston. These constitute the board of directors.

In the United States Senate, February 8th, Senator Harris reported back from the committee on finance the bill relating to the proposed pioneer electric railroad between Chicago and St. Louis with a substitute permitting the importation free of duty of multiphase motors, generators and transformers necessary for the construction and equipment of such railway.

A press dispatch from Little Rock, February 9th, says: The receivership case of the Thomson-Houston Electric company of Chicago against the Electric Street Railway company was taken up to-day by Chancellor Carroll. An amendment to the complaint, making the Bank of Commerce of St. Louis one of the defendants, was filed, and the intervention of the St. Louis Trust company, which holds $300,000 of the mortgage bonds, was withdrawn. The street railway company filed its answer and made a general denial to the allegations contained in the application for a receiver. Great quantities of testimony were introduced. The case will occupy the attention of the court for several days.

The inhabitants of Montreal are much concerned at the thorough way in which the electric snow plow clears their streets. It is well known that the gay Canadian city holds high revel during the winter months, and with sleighing, skating, tobogganing and snow-shoe tramping the time passes merrily. A curious contingency has arisen out of the introduction of electric street lines, which threatens to seriously restrict one of the most cherished of their winter recreations. That the electric cars may run without interruption after a fall of snow, the snow plows are put on, and they do their work so well that the road is spoiled for sleighing. A petition, signed by 10,000 inhabitants, has been presented that the electric cars may be discontinued in winter, and such is the love of sport among the hardy Canadians that it is possible that a season schedule of car running may be arranged.

J. Miller Kelly of Rochester, N. Y., has invented an attachment for electric cars that will, it is claimed, prevent the cars from running over persons who may be so unfortunate as to get on the track at the wrong time. The invention resembles in one feature the horizontal grate platform invented by Congressman Tom Johnson of Cleveland. The Johnson platform projected several feet in front of the car; it was fixed and immovable and stood six inches or more from the rails. Mr. Kelly's apparatus has a horizontal platform, also, made of wire netting attached to a gas pipe frame. It does not project over a foot in front of the car and is hinged at its rear end to allow of a perpendicular movement. When the car is running and nothing in the way of an obstruction is on the track the platform is up half a foot from the rails and is held in that position by a hook attached to a perpendicular apron which stands a foot in front of the body of the car. This apron is made of wire netting on gas-pipe supports, and swings in toward the car. If the car runs against a man and knocks him down the contact releases the hook on the suspended apron which supports the outer end of the horizontal platform The platform then falls down close to the rail and scoops up the object on the track, the apron at the same time swinging back so that it does not prevent the fallen body from being taken up by the platform. The whole apparatus is under the control of the motor-man who, by stepping on a lever, throws the catcher into position for operation.

The Bergen County, N. J., Board of Chosen Freeholders will be asked to grant the privilege of laying a double-track trolley road on the old Paterson Plank Road from Passaic city to and across the Hackensack river by way of Secaucus bridge; and the Hudson county and Hoboken city authorities will be asked for permission to continue the line through roads and streets in their territory to Hoboken ferry. The line is a continuation of the road now connecting Paterson and Passaic city. The fBergen county committee on Paterson Plank Road met a number of interested gentlemen last week and went over a part of the proposed route. It is intended to lay a track on each side of the public road, leaving the present twenty feet macadamized wagon-way between, the car tracks to be so laid that wagons can pass over them if necessary. It is believed that the line through Bergen and Hudson counties will cost about $500,000. It will pass through a thickly settled suburban district in part, including Rutherford, Boiling Springs, and Carlstadt. Among those mentioned as financially connected with the enterprise are President McCall of the New York Life Insurance company, President Henry B. Hyde of the Equitable Life Association of the United States, Gen. Louis Fitzgerald, president of the Mercantile Trust; C. A. Johnson of Johnson, Kenny & Co., Ex-Senator Charles H. Russell of Brooklyn, Charles Currie and Thomas D. Jordan. It is expected that the system will eventually branch out to other towns in Bergen and Hudson counties.

TELEPHONE.

The Bell Telephone company's directors, it is said, will shortly issue $2,500,000 of their authorized $10,000,000 of new stock.

The long-distance telephone line between Chicago and Boston was formally opened on the 7th instant. De Wolf Hopper sang several songs at the Chicago end, and the words were plainly heard at Boston, 1200 miles away.

TRADE NEWS.

J. W. Parker & Co., Philadelphia, representatives of the Ball Engine company, Erie, Pa., are installing an 80 horse power Ball engine at Malden, W. Va., for experimental mining haulage.

C. E. Brown of the Central Electric company has just returned to Chicago from a very successful trip, both in the way of orders and expressions of good will from the Central's customers whom he visited.

P. C. Ackerman, New York representative of the American Electrical Works, of Providence, R. I., was in Chicago last week. Mr. Ackerman reports business as being very good, especially for railway feeder and trolley wire.

J. J. Ryan & Co., Chicago, have a thoroughly equipped brass foundry. They manufactore brass castings, aluminum castings, phosphor bronze castings, manganese bronze castings, aluminum bronze and brass castings and silicon bronze castings.

The new Acme lamp adjuster for regulating incandescent lamps, which is being placed on the market by the Electric Appliance company, is meeting with a ready sale. The adjusting mechanism, in the form of a rosette, is attached to the ceiling instead of being suspended on the cord.

The Hart & Hegeman Manufacturing company of Hartford, Conn., reports the sales of snap switches for the month of January as being larger than that of any previous month since last July. The sales from orders already received for the month of February will te even greater than the month of January.

The Enterprise Electric company, 307 Dearborn street, Chicago, reports that local business has increased to such an exteot that it has been necessary to secure a delivery truck of its own. The company wishes to call the attention of its Chicago customers to the fact that it now does its own delivering, and can guarantee prompt delivery of all orders.

The Perkins Electric Switch Manufacturing company of Hartford, Conn., reports a good business for its new lamp sockets. It also reports large sales since the first of the new year for dovetail ceiling rosettes, especially for molding, cleat and concealed work. The company has now under way several new styles of sockets and rosettes for the spring and summer trade.

General Agent J. T. Maxwell, of the Edison Electric Light company, of Philadelphia, reports that the company will make additions in its lighting capacity that will reach the 100,000 figure. This company has been one of the most prosperous lighting conceros in the country. Its fair treatment of its customers has won many friends.

W. R. Mason, the general manager of the Railway Equipment company, Chicago, has just sent out a circular to the eastern trade, calling attention to the facilities of the company for furnishing everything necessary for the complete equipment and maintenance of electric roads, and also calling particular attention to the merits of the Type "G" overhead material manufactured by his company. This material has been specified on a majority of the leading roads during the last season.

One of the handsomest and most attractive designs in the way of desk advertising is that which the Standard Paint company of New York is sending to its many friends. It consists of a porcelain plate, 10x8 inches, paper covered back, with a support upon which is printed in shaded letters of gold, green, red and blue the words "Preservative paints." It also calls attention to the insulating compound, armature varnish, etc., and the P. & B. trade mark occupies a conspicuous position.

The Chicago Edison company has awarded the contract for the pumps, condensers, etc., for its new central station to Henry R. Worthington. The contract calls for two circulating pumps 10 by 18 and 26 by 18, three vertical marine feed water pumps, four 600 horse power and two 1200 horse power surface condensers with attached vacuum pumps and a 10,000 horse power marine feed water heater, a duplicate of the feed water heaters furnished by the same concern for the City of Paris and the City of New York. The contract is the largest of the kind that has been awarded in Chicago for some time.

The American Electrical Works have recently purchased from Charles Fletcher the Richmond Paper company's mills in East Providence, R. I. This property originally cost the paper company $1,000,000, and was sold January 11th, at auction, to Charles Fletcher. The plant consists of about 28 acres of land, three miles from the city of Providence upon the Seekonk river and upon the Providence and Worcester railroad, affording excellent water and railroad communication. The buildings are mainly of brick and of the following dimensions: One building, 160x65, four stories; one building, 200x50, one story, with attic; two buildings, 150x60, one story; one building, 200x30, one story; one building, 200x40, one story; one building, 130x60, one story. The steam plant consists of two Greene improved engines of 600 horse power each, and 14 six feet horizontal tubular boilers, in good order. The water supply is abundant, and of good quality. The plant will be used for the extension of their growing busi-

ness, which is due in a large measure to the ability and perseverance of Messrs. Phillips, Hathaway and Sawyer.

About a year ago the manufacturer of the Bryant switch, wishing to place upon the market a single pole switch in quality equal to his double pole switch, purchased the patents, stock and the machinery of H. T. Paiste. The Bryant company at that time also purchased the patents on the K. W. cut-outs and rosettes. The company opened a western office in Chicago to take care of the business in this section of the country, and soon largely increased the volume of its business in the West. It is now announced that W. B. Cleveland has assigned the entire interest in the Cleveland switch to the Bryant Electric company of Bridgeport, Conn., together with the tools, patterns and molds for making the switches and arc cut-outs formerly manufactured and sold by the Forest City Electric Works of Cleveland, O. This is an important addition to the company's products.

BUSINESS.

P. C. Burns has disposed of his interest in the Peru, Ind., Electric Manufacturing company, and has severed his connection with that concern.

The Detroit Electrical Works announce the appointment of L. E. Myers as district manager, with offices at 917 and 918 Monadnock building, Chicago.

The Newcastle Steel company, Newcastle, Pa., is placing a 200 horse power Ball engine, manufactured by the Ball Engine company, Erie, Pa. The Milton, Pa., Electric Light company is also putting in a 100 horse power Ball engine, furnished by J. W. Parker & Co., Philadelphia representatives of the Ball company.

The Ford-Washburn Storelectro company, Cleveland, O., has just opened a branch office in Chicago at 206 Temple Court building, with Frank D. Rushing as manager. Business Manager C. J. Swift is now at the helm in the central office at Cleveland. Mr. Swift, it will be remembered, severed his connection with the Duplex Electric company, of Corry, Pa., to take charge of the affairs of the Ford-Washburn Storelectro company, and under his aggressive policy the company is making itself felt in the West in a manner that speaks well for a continuance of the steady growth of business.

The Nowotny Electric company of Cincinnati, O., well known in electrical circles as the manufacturer of electrical supplies, reports an active business in the new line it has recently taken up. This company, it might be well to explain, a short time ago entered upon the business of bartering electrical machinery; that is, the company holds itself in a position both to buy and sell not only new apparatus but that which has seen some service as well. The Nowotny company is in the market to buy electric light and power machinery; it rebuilds apparatus and keeps a stock of thoroughly overhauled machines that are in a condition practically equal to new apparatus. The company's headquarters are at 30 East Fifth street, Cincinnati, O.

The Central Electric company, Chicago, has sold in the last few days upwards of one million feet of Okonite in assorted sizes, but in spite of these heavy demands the company is able to keep pace with its orders and to satisfy customers. The sales of the Washington carbon, which has come to the front in the hands of the Central Electric company, have been enormous, and the factory has been compelled to double its capacity. Interior conduit has been in demand during the week, several of the larger buildings of Chicago being equipped with this system. Romaine Mace, the representative of the company, is in the city and makes his headquarters with the general western agent, the Central Electric company, giving it the benefit of his experience.

Among the sales recently made by the Chicago office of the Ball Engine company, Erie, Pa., are the following: Calumet Electric Street Railway company, Chicago, four 300 horse power cross compound electric railway engines; Hammond Electric Street Railway company, Hammond, Ind., one 150 horse power steam plant complete; H. D. Bentley, Freeport, Ill., one 35 horse power steam plant complete; Elmwood Electric Light company, Elmwood, Ill., one 150 horse power engine; Union Passenger station, Chicago, one 125 horse power engine; Keith Bros. & Co., Chicago, one 50 horse power engine; Marengo Electric Light company, Marengo, Ia., one 100 horse power steam plant complete; Scott & Royce, Griggsville, Ill., one 50 horse power steam plant complete; Western Light & Power company, Chicago, one 300 horse power engine; Englewood Electric Light company, Chicago, one 500 horse power cross compound engine.

E. P. Roberts & Co., mechanical and electrical engineers, now have their office in the Western Reserve building, Cleveland, O., and are engaged in general electrical and mechanical consulting work. This concern is prepared to make designs and specifications for plants of all descriptions and for machines to be built for special purposes as well. L. P. Roberts is well known among technical men, having been in the electrical business since 1880. Mr. Roberts was for three years professor of electrical engineering of Cornell University. The other member of the firm is C. F. Uebelacker. Mr. Uebelacker is an associate member of the American Institute of Electrical Engineers and, it may be also mentioned, was graduated from Princeton College. It is most reasonable to assume that this firm will command its share of western engineering business. The firm has now in view several electric railway projects and it will undoubtedly do a good business in other lines.

Robert Hirsch and Herman Meminger of Milwaukee have invented a commutator brush for dynamos which possesses many advantages. A test covering the past eight months has been made and is said to have resulted satisfactorily. The inventors have disposed of their rights to the Wisconsin Electrical Construction company, of Milwaukee. The brush looks like a square chunk cut out of an inch board. The inside of the block is composed of numerous strips of copper which bear on the commutator and form the conductor. Between the strips of copper is a mixture, the principal constituent of which is graphite. In the mixture is also a gritty substance which keeps the commutator clean, while the graphite acts as a lubricant. The brush does not wear so rapidly as might be expected, although the wear is on the brush almost entirely. The invention will be particularly valuable to electric car companies. A desirable feature is that it will do away with the singing noise which is made by the commutator and the old-style brush. The Milwaukee electric cars will be provided with the new brushes. The manufacture of the brushes will be carried on at the Pabst power house.

ELECTRICAL PATENTS.

Issued February 7, 1893.

491,095. Electric Arc Lamp. Wallace E. Freeman, Long Island City.

A centrally pivoted lever carries upon its ends the cores of the shunt and series solenoids, and is provided with a cam which engages with and regulates the action of the carbon clutch in grasping and releasing the carbon rod.

491,106. Bipolar Electrical Machine. Thomas H. Hicks, Detroit, Mich.

The invention relates to a bipolar compound self-exciting alternating machine. A commutator is provided which commutes a portion of the armature current that traverses the shunt winding of the machine. The main current passes first through a two-part commutator, being straightened and passing through the series winding and back to the two-part commutator, where it is again transformed into an alternating current, and passes to the working circuit.

491,109. Telephone Cable. Silas W. Holman, Boston, Mass.

Adjacent strands of the cable are twisted together at different pitches in order to prevent inductive action between the strands.

491,124. Arc Light Carbon. James McLaughlin, Chicago, Ill.

The carbon consists of a plurality of separated members, integrally joined together at one end. In burning the arc will automatically shift from member to member as the resistances of the paths change.

491,131. Machine for Centrifugally Treating Molten Materials. Orrin B. Peck, Chicago, Ill.

491,132. Inclosed Conductor for Electric Railways. Frank C. Perkins, Dunkirk, N. Y.

The insulated feed conductor is enclosed within a flexible metallic tube, normally resting out of contact with the feed conductor. As the trolley wheel passes over the metallic tube it presses the latter against the feed conductor, thus completing circuit between the trolley wheel and the feed conductor.

491,133. Printing Telegraph Receiver. Major D. Porter, Brooklyn, N. Y.

491,163. Vibratory Telegraphy. Stephen D. Field, Yonkers, N. Y.

491,171. Retouching Device. Albert S. Harry, Steubenville, O.

491,208. Insulator Clip. William H. Edmunds, New York, N. Y.

491,210. Trolley Stand. Samuel Harris, Cleveland, O.

491,250. Testing Apparatus for Multiple Switch-Board Systems. Charles E. Scribner, Chicago, Ill.

A battery is placed in connection with that strand of the cord which connects with the sleeve of the plug, a winding of the clearing out annunciator being included in circuit with the battery. In this manner the clearing out annunciator is made to perform its own function, and in addition permits the test battery to be applied in a ground branch without destroying the balance between the two sides of a metallic circuit.

491,251. Duplex Electric Arc Lamp. Charles E. Scribner, Chicago, Ill.

An electro-magnetic device is connected with one of the lower carbon supports, and is so connected with the circuit of the lamp that the support will be lowered when the lamp is first brought into service, and raised again, carrying with it both the upper carbons, the operation being repeated each time the arc is shifted, the length of the stroke of the movable support determining the amount of carbon that is consumed between each shifting of the arc.

491,252. Metallic Circuit for Multiple Switch-Board Systems. John A. Seely, New York, N. Y.

A ground connection is provided for both branches of a metallic circuit at the subscriber's station, so that the ordinary call may be made over one branch or limb of the circuit, while the other limb connected with the insulated frames of the different switches of the line may be used as a test wire. When the subscriber takes his telephone from the switch, the ground connection is broken at the subscriber's station, and the two branches or limbs are united at the central office through a pair of loop plugs and cords.

491,268. Lamp-Socket. Edwin R. Elliott, Litchfield, Ill.

A longitudinally movable bar projects from the socket at both ends, and is provided with buttons which may be pressed to move the rod from one to the other of its two positions. A projection upon the bar engages with an arm that makes and breaks the circuit by its movement.

491,275. Telephone Transmitter. Harry L. Tyler, Corning, N. Y.

A hook is carried upon the back of the diaphragm to which is secured one end of a chain composed of carbon links, the other end of the chain being carried upon an adjustable slide. The variable pressure between the links of the chains serve to alter the resistance of an electric circuit in which the chain is included.

491,294. Dynamo Electric Machine. Gabriel V. M. A. Parrot and Antoine C. Reignier, Paris, France.

The conductors of the armature are composed of a magnetic metal, and a good conductive metal as iron and copper, superposed and welded together. These conductors are wound upon a non-magnetic core no magnetic material being provided in the armature core. The iron in the armature conductors serves the purpose of the iron core of the ordinary armature, that of furnishing a path for the lines of magnetic force, while at the same time currents induced in the iron analogous to the Foucault currents of the ordinary armature core, will be in the direction of the currents induced in the copper, and will be conducted to the latter and assist in supplying the working circuit.

491,311. Electrically Heated Soldering Iron. Samuel B. Jenkins, Boston, Mass.

The invention embodies means for bringing a great length of wire in close contact with the core so that each wire is adjacent to the core, and is not separated from it by other layers. To effect this condition the mass of iron to be heated is provided with a number of projections around and about which the wires are wound.

491,312. Electrically Heated Smoothing Iron. Samuel B. Jenkins, Boston, Mass.

The smoothing iron is provided upon its upper surface with a number of parallel projections, around and about which are wound the conducting wires.

491,313. Electric Curling Iron Heater. Samuel B. Jenkins, Boston, Mass.

491,320. Electric Water Heater. Willis Mitchell, Malden, Mass.

The water heater is in the form of a vertical cylinder filled with water, and provided with a metallic bottom, upon the under side of which are formed projections around which are wound the electric conductors. The passage of the current through the conductors heats the cores, and the heat is conducted to the water in the cylinder. Passing through the cylinder is a coiled pipe through which the water to be heated is passed.

491,321. Electrically Heated Vessel. Willis Mitchell, Malden, Mass.

491,322. Electrically Heated Gridiron. Willis Mitchell, Malden, Mass.

491,339. Electric Clock. John H. Dyson, Belleville, Wis.

491,346. Electro Mechanical Movement. Elisha Gray, Highland Park, Ill.

The movement is adapted for transmitting telautographic messages. In this method of transmitting messages the pen with which the message is written is guided by hand. To the pen are attached two cords, which extend at right angles, and pass around drums. When the pen is moved as in writing the characters these drums are wound and unwound more or less and are so arranged that when they are moved through a certain distance a circuit is broken a number of times, the number depending upon the distance the drums move. The circuits controlled by the drums extend to the receiving station, where are provided in each circuit, step by step, devices which are brought into action upon the passage of momentary currents to give to a pen at the receiving station a motion corresponding to the motion of the transmitting pen. The invention relates to a means of causing consecutive breaks in the circuit when the transmitting pen is moved.

491,347. Telautograph. Elisha Gray, Highland Park, Ill.

491,361. Electric Railway Trolley. Benjamin Kochs and Albert Kochs, St. Louis, Mo.

The trolley arm supports a horizontal arm carrying upon each end a trolley wheel.

491,362. Insulator. Augustus R. Lane, New York, N. Y.

491,369. Electric Lock. Oliver A. Moyer and Henry W. Rhodes, Ogden, Utah.

491,387. Electric Circuit for Railway Signaling. Louis Thaler, New York, N. Y.

Connected insulated bars are sustained on the rails and project slightly above the top faces of the rails and a battery and an indicator are included in open circuit with the bars, which circuit is closed by the wheels upon the passage of the train.

491,394. Process of Electrically Reducing Aluminum and Forming Alloys Thereof. Thomas L. Willson, Brooklyn, N. Y.

491,412. Windlass for Lowering or Raising Street Electric Lamps. Charles R. Eddy, Springfield, Mo.

491,437. Electric Metal Heating Device. Willis Mitchell, Malden, Mass.

491,426. Combined Electric Switch and Door Lock. John H. L. Holcombe, U. S. Navy.

491,438. Electrically Heated Muffle. Willis Mitchell, Malden, Mass.

A carbon is composed of a mixture of plumbago and fire clay, the proportion of fire clay being greater at the heat producing end than at the other end.

491,457. Electrical Measuring Instrument. Elmer G. Willyoung, Philadelphia, Pa.

The needle is supported in pivot bearings, and is made dead-beat by the employment of a piston and air cylinder, so that the needle will not swing beyond the proper point of deflection.

491,465. Electrical Transmission of Power. Charles S. Bradley, Avon, N. Y.

491,483. Switch for Electrical Tram Cars. Moritz Immisch, London, Eng.

491,484. Electrically Heated Vessel. Samuel B. Jenkins, Boston, Mass.

491,490. Insulation of Dynamo Armatures. Thomas E. Morford, Minneapolis, Minn.

491,491. Insulated Magnetic Coil. Thomas E. Morford, Minneapolis, Minn.

11,303. Method of Insulating Electric Conductors. Thomas E. Morford, Chicago, Ill.

A coating of enamel is placed upon the body to be heated, upon which is placed the electrical conductor; a compressible non-conducting substance is then placed over the conductors and compressed into position.

11,306. Multiple Switch Board System. Charles E. Scribner, Chicago, Ill.

Eugene F. Phillips, Prest. W. A. Hathaway, Treas. W. H. Sawyer, Sec'y.

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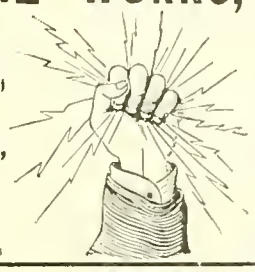

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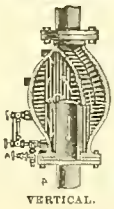

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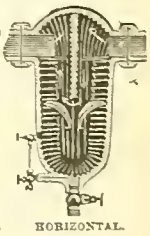

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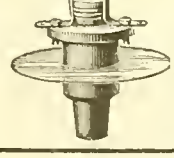

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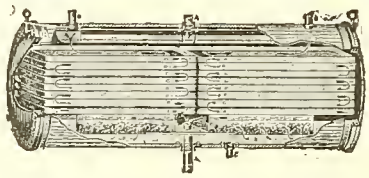

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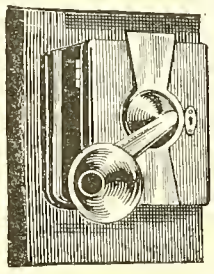

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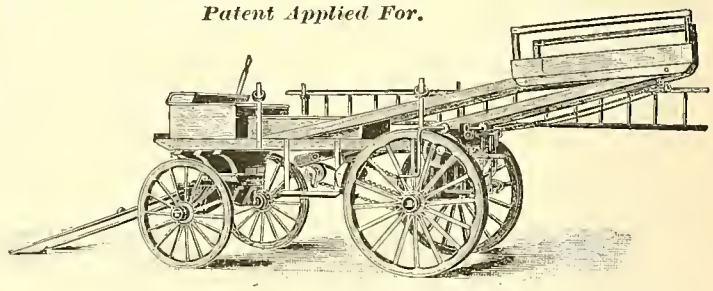

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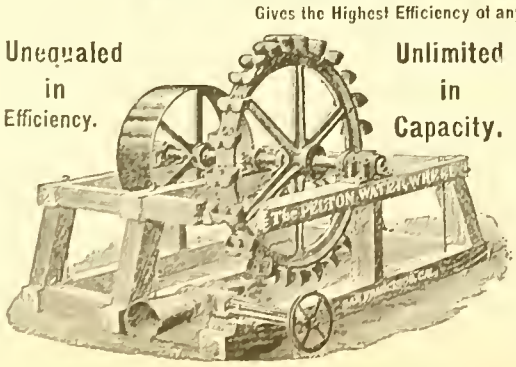

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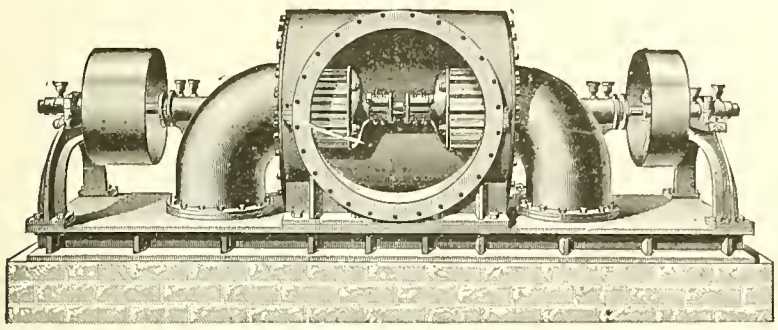

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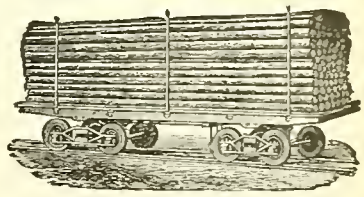

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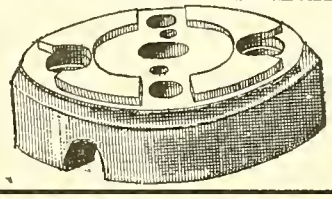

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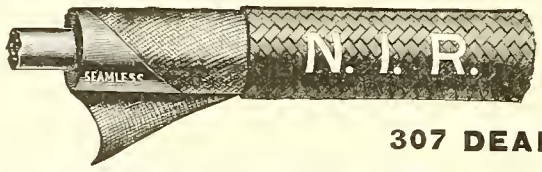

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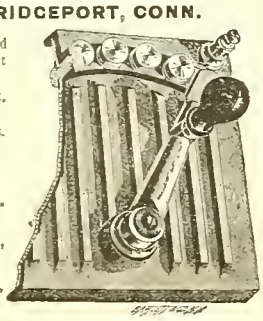

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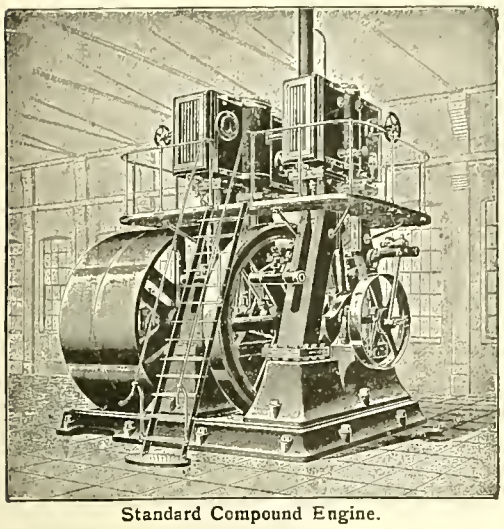

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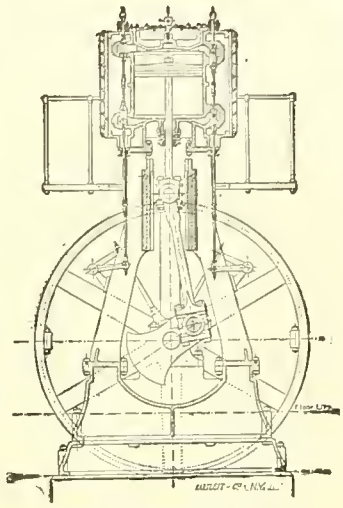

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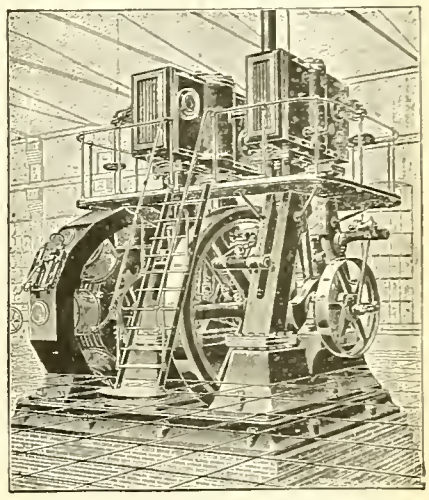

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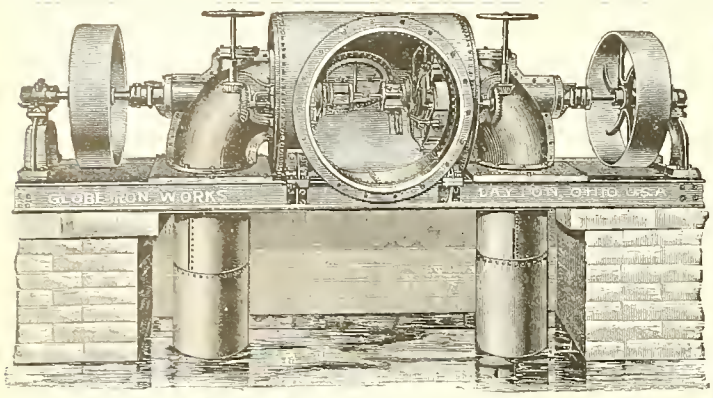

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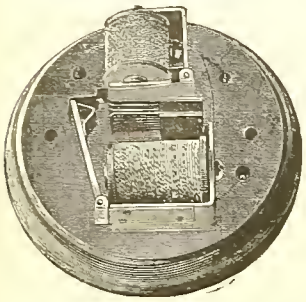

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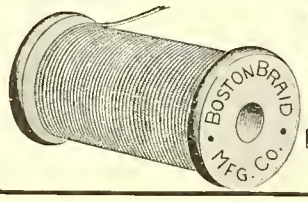

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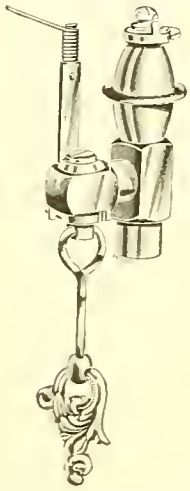

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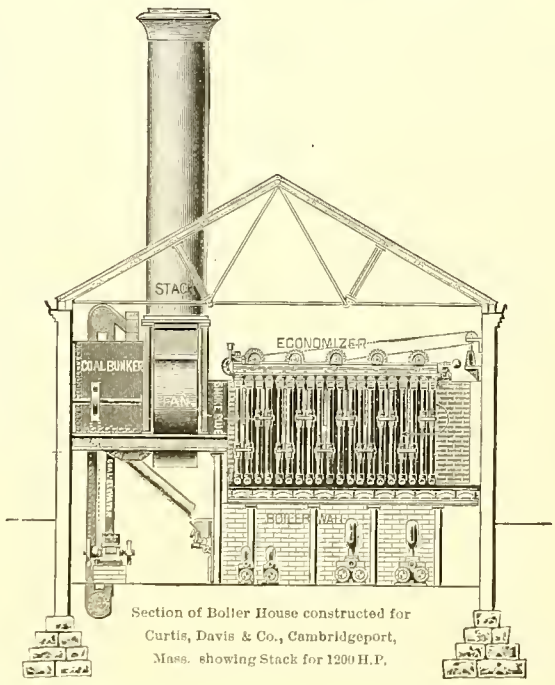

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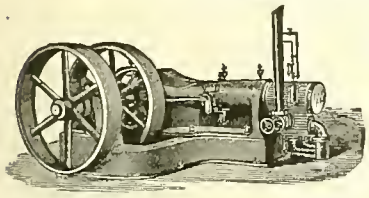

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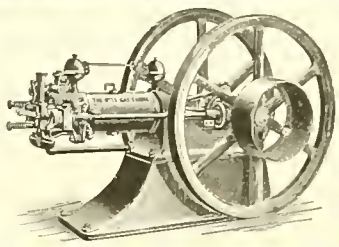

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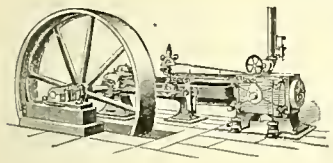

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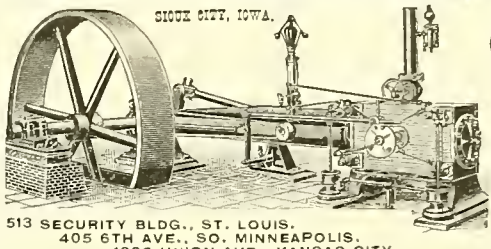

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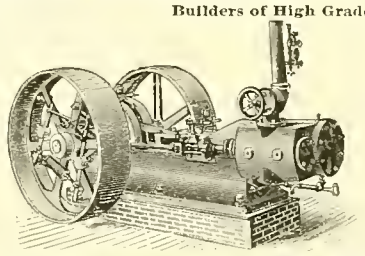

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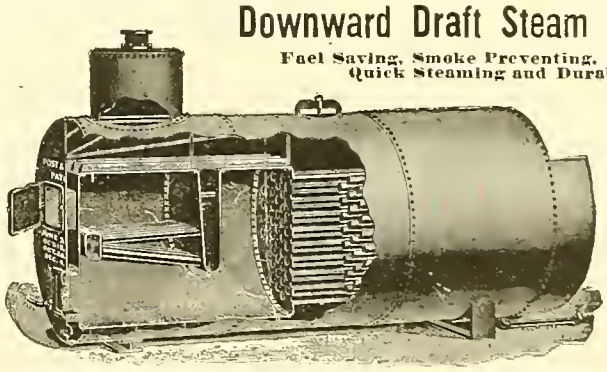

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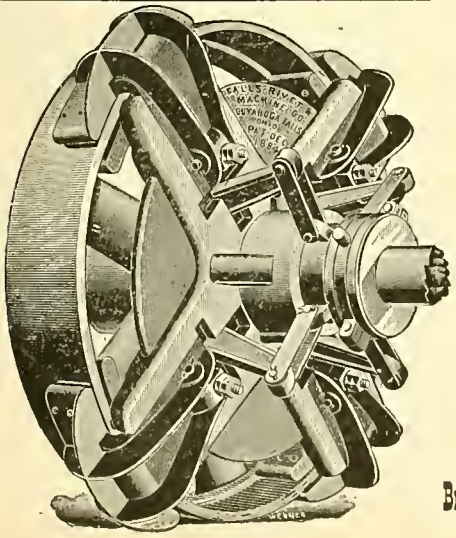

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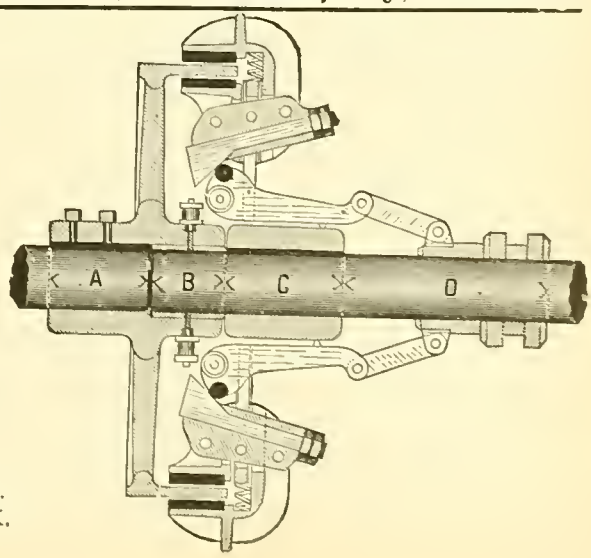

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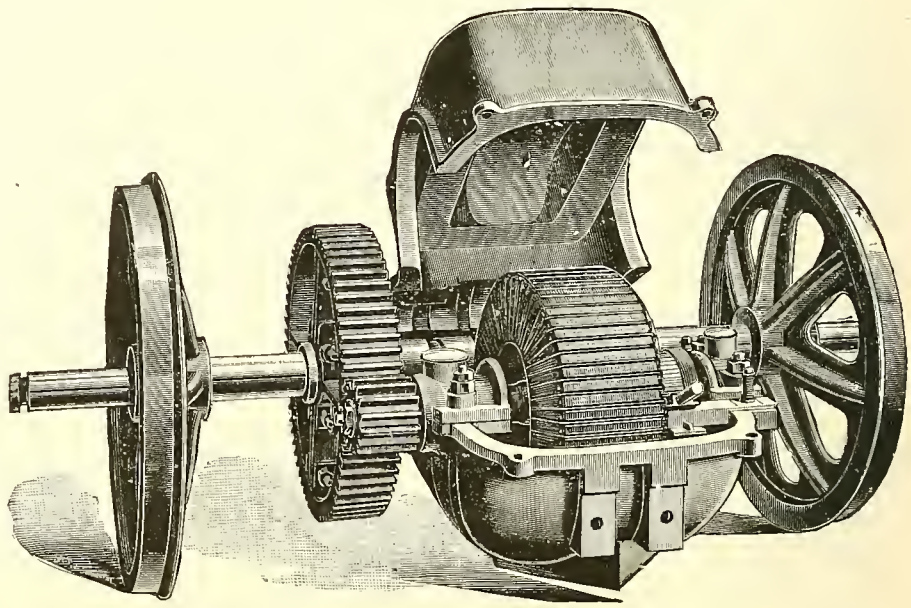

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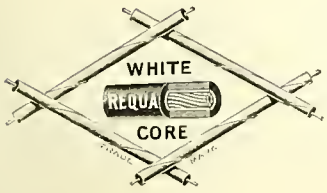

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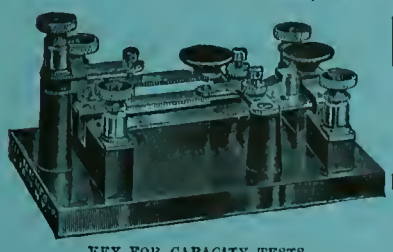

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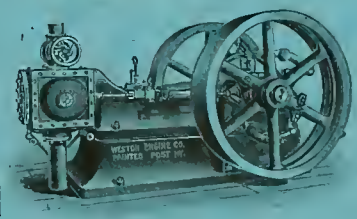

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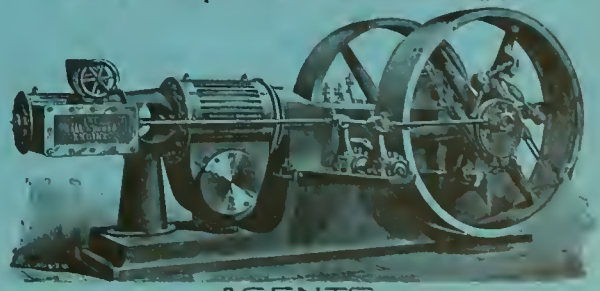

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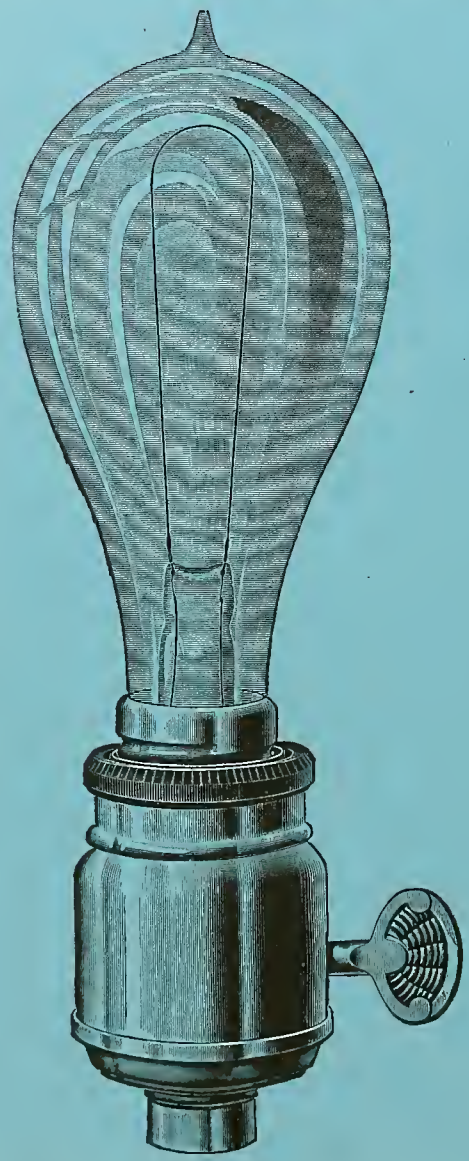

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N. Y. Safety Steam Power Co.
Weston Engine Co.

Books, Electrical.
Electrician Publishing Co.

Braiding Machinery.
New England Butt Co.

Burglar Alarms.
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.

Cables.
(See Insulated Wires.)

Cables, Electric. (See Insulated Wires), **Copper, Sheet and Bar**
Bishop Gutta Percha Co
Eastern Electric Cable Co.
Moore, Alfred F.
Roebling's Sons Co., J. A.
Washburn & Moen Mfg. Co.
Western Electric Co.

Carbons, Points and Plates.
Central Electric Co.
Knapp Electrical Works.

Castings.
Palmer Bros.

Clutches, Friction.
Falls Rivet & Machine Co.
Hill Clutch Works.

Cordage.
Samson Cordage Works.

Construction and Repairs.
Comstock, Louis K.
Electric Cons. & Supply Co.
McLean & Schmitt.
Roberts, E. P. & Co.
Western Electric Co.
Wilson & Jackson.

Contractors, Electric Light, Engine Plants and Electric Railways.
American Engine Co.
Babcock & Wilcox Co., The.
Ball & Wood Co., The.
Brush Electric Co.
C. & C. Electric Motor Co.
Cabell, L. Breckinridge.
Comstock, Louis K.
Ford-Washburn Storelectro Co.
Freeman Sons Mfg. Co., The S.
General Electric Co.
Great Western Mfg. Co.
Hatheway, E. M.
Heisler Electric Co.
Lake Erie Engineering Works.
Lane & Bodley Co., The.
La Roche Electric Works.
Morse & Co., A. M.
N. Y. Safety Steam Power Co.
Osborne Steam Engineering Co.
Pearson & Co., W. B.
Racine Hardware Mfg. Co.
Rockford Electric Mfg. Co.
Siemens & Halske Electric Co.
Sioux City Engine Works.
Standard Electric Co.
Waddell-Entz Company.
Westinghouse Electric & Mfg. Co.
Westinghouse, Church, Kerr & Co.
Western Electric Co.
Weston Engine Co.
Wilson & Jackson.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Electric Co., The.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cutter, Geo.
Enterprise Electric Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Moore, Alfred F.
National India Rubber Co.
Phillips Insulated Wire Co.
Roebling's Son's Co., J. A.
Sperry Elec. Mining Machine Co.
Washburn & Moen Mfg. Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Hughes Bros. Mfg. Co.
Knapp Electrical Works.
Loud, H. M. & Sone Lumber Co.
Railway Equipment Co.

Cut-Outs and Switches.
Ansonia Electric Co., The.
Bryant Electric Co.
Central Electric Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Electric Engineering & Supply Co.
Enterprise Electric Co.
Great Western Mfg. Co.
Hart & Hegeman Mfg. Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Perkins Elec. Switch Mfg. Co.
Redding Electric Co.
Russell & Officer.
Sawyer-Man Electric Co.
Sechriet, A.
Utica Elec. Mfg. & Supply Co.

Dynamos.
Brush Electric Co.
C. & C. Electric Motor Co.
Duplex Electric Co., Ltd.
Electrical Eng. & Supply Co., The.
General Electric Co.
Great Western Mfg. Co.
Heisler Electric Co.
La Roche Electric Works.
National Electric Manufacturing Co.
Nowotny Electric Co.
Rose Electric Light Supply Co.
Siemens & Halske Electric Co.
Standard Electric Co.
Waddell-Entz Company.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Heating.
Ansonia Electric Co., The.
Railway Equipment Co.

Electric Lava Gas Tips.
Smith, A. T.

Electric Railways.
General Electric Co.
Siemens & Halske Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical and Mechanical Engineers.
Comstock, Louis K.
Hatheway, E. M.
Osborne Steam Engineering Co.
Roberts, E. P. & Co.
Wilson & Jackson.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Knapp Electrical Works.
Queen & Company.
Western Electric Co.

Electrical Intelligence.
Comstock, Louis K.
Hatheway, E. M.
Roberts, E. P. & Co.
Wilson & Jackson.

Electrical Specialties.
Columbia Mfg. & Supply Co.
Cutter, Geo.
Holtzer-Cabot Electric Co.
Russell & Officer.
Utica Elec. Mfg. & Supply Co.

Electrician's Torches.
Clayton & Lambert Mfg. Co.

Electroliers and Combination Fixtures.
Ansonia Electric Co., The.
Baggot, E.
Edwards, W. S. Mfg. Co.
Knapp Electrical Works.

Electro-Plating Machines.
Brush Electric Co.
General Electric Co.

Engines, Gas.
Otto Gas Engine Works.

Fan Outfits.
Diehl & Company.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Engines, Steam.
American Engine Co.
Ball & Wood Co., The.
Freeman Sons Mfg. Co., The S
Lake Erie Engineering Works.
Lane & Bodley Co., The.
Morse & Co., A. M.
N. Y. Safety Steam Power Co.
Pearson & Co., W. B.
Racine Hardware Mfg. Co.
Sioux City Engine Works.
Taylor Engine Co.
Westinghouse, Church, Kerr & Co.
Weston Engine Co.

Fire Alarms.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Fuel Economizers.
Fuel Economizer Co.

Fuse Wire.
Ansonia Electric Co., The.
Knapp Electrical Works.
Shawmut Fuse Wire Co.
Sperry Elec. Mining Machine Co.

Gas Lighting, Electric.
Boston Electric Co.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.

General Electrical Supplies.
Angier & Kennard.
Ansonia Electric Co., The.
Bryant Electric Co.
Central Electric Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Electric Eng. & Supply Co.
Electrical Eng. & Supply Co., The.
Enterprise Electric Co.
General Electric Co.
Great Western Mfg. Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Palmer Bros.
Partrick & Carter Co.
Penn. Electric Engineering Co.
Queen & Co.
Redding Electric Co.
Russell & Officer.
Sawyer-Man Electric Co
Sioux City Elec. Supply Co.
Utica Elec. Mfg. & Supply Co.
Waterhouse, Gamble & Co.

Globes and Electrical Glassware.
Angier & Kennard.
Brookfield, Wm.

Graphite Specialties.
Dixon Crucible Co., Jos.

Hard Rubber Goods.
Butler Hard Rubber Co.
Delaware Hard Fibre Co.

Insulators and Insulating Materials.
Ansonia Electric Co., The.
Brookfield, Wm.
Bryant Electric Co.
Butler Hard Rubber Co.
Electric Engineering & Supply Co.
Empire China Works.
Enterprise Electric Co.
General Electric Co.
Hart & Hegeman Mfg. Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Knapp Electrical Works.
Mass. Chemical Co.
Moore, Alfred F.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Standard Paint Co.
Utica Elec. Mfg. & Supply Co.
Vulcanized Fibre Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Ansonia Electric Co., The.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Cutter, Geo.
Eastern Electric Cable Co.
Electric Appliance Co.
Enterprise Electric Co.
General Electric Co.
Great Western Mfg. Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & G. P. Ins. Co.
Knapp Electrical Works.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Shawmut Fuse Wire Co.
Sperry Elec. Mining Machine Co.
Waddell-Entz Company.
Washburn & Moen Mfg. Co.
Western Electric Co.

Lamps, Incandescent.
Ansonia Electric Co., The.
Beacon Vacuum Pump & Elec. Co.
Bernstein Electric Co.
Buckeye Electric Co.
Central Electric Co.
Electrical Eng. & Supply Co., The.
Electrical Manufacturing Co., The.
General Electric Co.
Knapp Electrical Works.
New York and Ohio Co.
Penn. Electric Engineering Co.
Sawyer-Man Electric Co.
Steuben Lamp Works.

Lathes.
Bridgeport Machine Tool Works.
Shepard, H. L.

Lightning Arresters.
Knapp Electrical Works.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Ferracute Machine Co.
Bridgeport Machine Tool Works.

Medical Batteries.
Partrick & Carter Co.

Mica.
Johns Mfg. Co., H. W.
Munsell & Co., Eugene

Milling Machinery.
Becker Mfg. Co., John.

Mining Apparatus, Electric
General Electric Co.
Great Western Mfg. Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

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Brush Electric Co.
C. & C. Electric Motor Co.
Crocker-Wheeler Electric Co.
Electrical Eng. & Supply Co., The
Ford-Washburn Storelectro Co.
General Electric Co.
Great Western Mfg. Co.
La Roche Electric Works.
Nowotny Electric Co.
Porter-Leavitt Electric Motor Co.
Rockford Electric Mfg. Co.
Siemens & Halske Electric Co.
Waddell-Entz Company.
Westinghouse Electric & Mfg. Co.

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Standard Paint Co.

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Rosenbaum, Wm. A.

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Partrick & Carter Co.
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(See electric railways.)

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Davis, W. S. & Son.

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Railway Equipment Co.

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American Electrical Works.
Ansonia Electric Co., The.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
India Rubber & G. P. Ins. Co.
International Okonite Co., The.
Knapp Electrical Works.
New York Insulated Wire Co.
Sawyer-Man Electric Co.
Standard Paint Co.

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Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co
Western Electric Co.

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Western Electric Co.

Telephone Mouthpieces.
Marcus, W. N.

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Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Company.
Western Electric Co.

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Diamond Electric Mfg. Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

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Samson Cordage Works.

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Westinghouse Electric & Mfg. Co.

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Mass. Chemical Co.
Standard Paint Co.

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Ansonia Electric Co., The.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Holmes, Booth & Haydens.
Knapp Electrical Works.
National India Rubber Co.
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MAKERS OF IRON, STEEL AND COPPER, and Manufacturers of IRON, STEEL AND COPPER WIRE for all Purposes.

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FOR ELECTRICAL PURPOSES.

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HARD DRAWN COPPER TROLLEY WIRE.

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ABSOLUTELY

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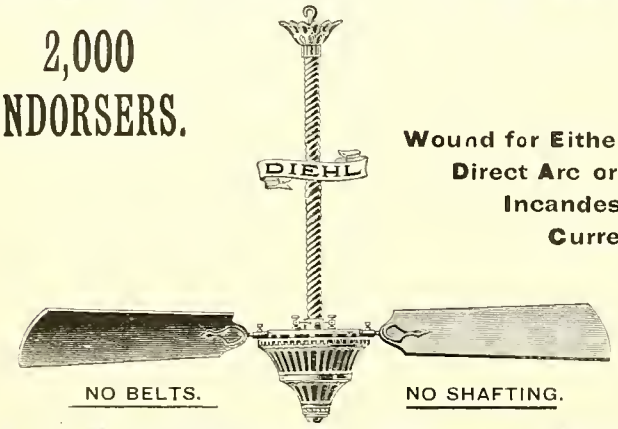

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Is made by the Planté process, no oxides being used, either mechanically or applied in the form of paste, paint or cement.

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LAMPS SENT ON TRIAL.

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Our New WORLD'S FAIR Switch.

Easily connected.

Elegant in Construction.

Safe Carrying Capacity.

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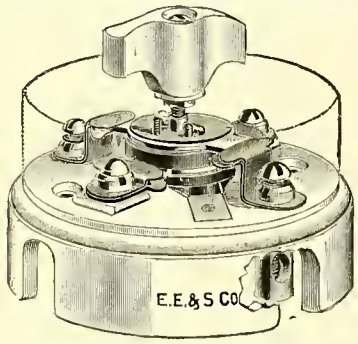

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Yet to be Excelled.

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A trial is Asked.

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Used Everywhere.

Sure Quick Break.

Endorsed by Users.

25 AMPERE DOUBLE POLE SNAP SWITCH.

This switch has more carrying capacity than most switches designed for 25 amperes, and the wiping contacts constantly keeping the surface clean, the parts always run cool. The sudden break is of such length as to make the switch safe for use with currents of no E. M. F. of from 400 to 600 volts.

This switch is finished in the same neat and workmanlike manner as are all our goods. Send for sample. Furnished with either rubber or porcelain key. Send for our Catalogue.

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OF EVERY DESCRIPTION.

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WESTINGHOUSE ELECTRIC & MFG. CO.,

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LONG DISTANCE TRANSMISSION OF POWER,

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548 Washington St., Boston,

MANUFACTURERS OF THE

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Please do not confuse our name with others.

We have the largest and most complete stock of Gas Lighting Apparatus to be found in this country. Our burners have proven, by practical use, to be far superior to any others on the market and our prices are exceedingly low.

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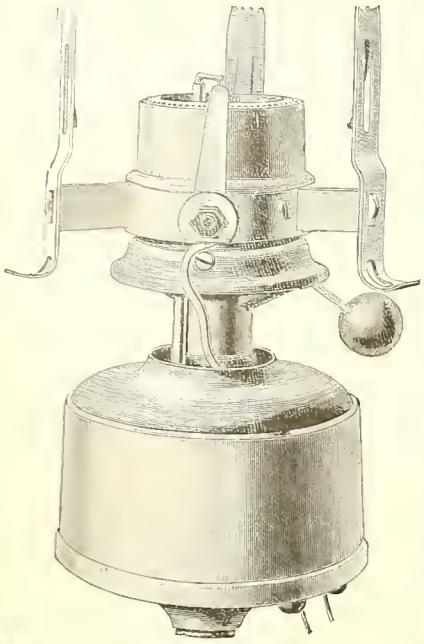
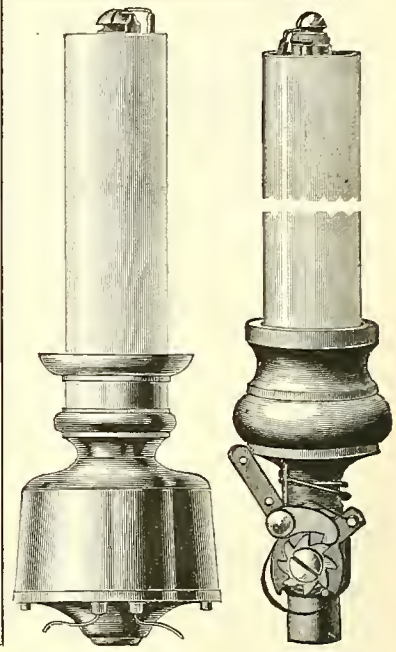
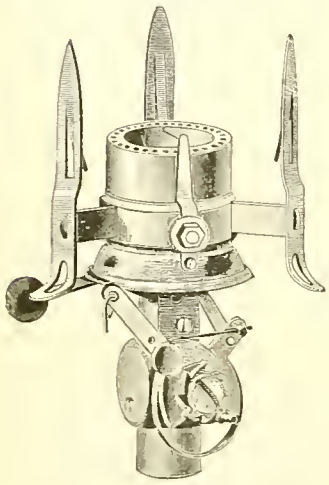


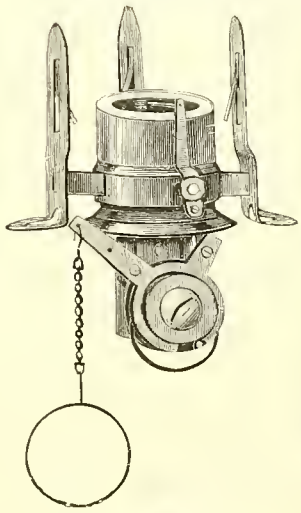
Argand Automatic Burner.



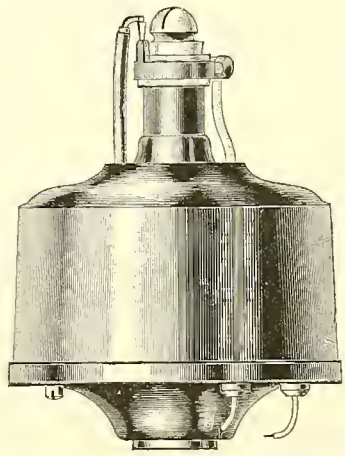
Candle Auto. Burner. Ratchet Candle.



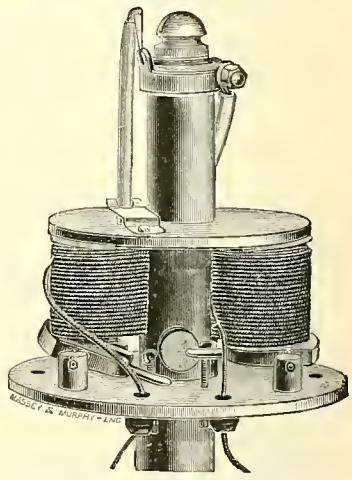
Ratchet Argand Burner.



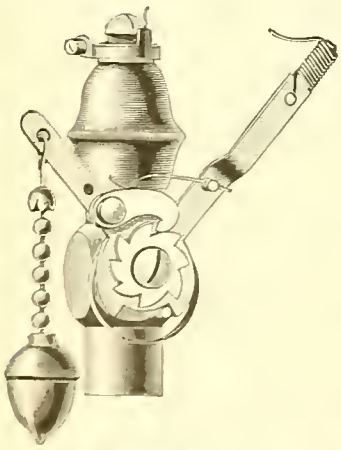
Plain Argand Burner.



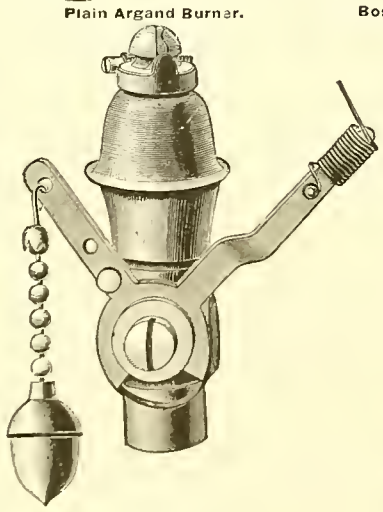
Boston Electric Co.'s Automatic Burner.



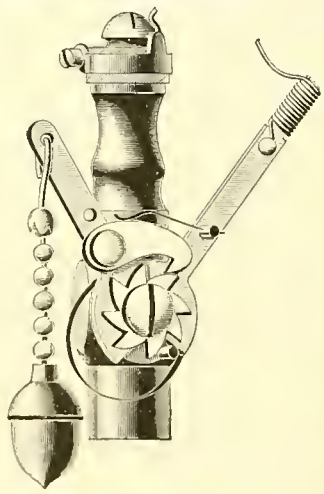
Boston Electric Autometic Burner.
(Shell removed.)



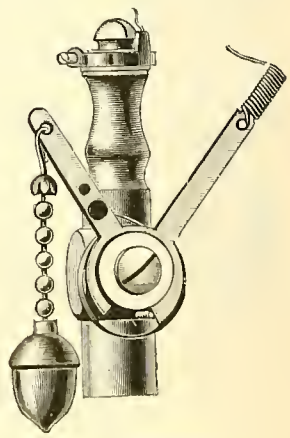
No. 3 Ratchet Burner.



No. 1 Plain Burner.

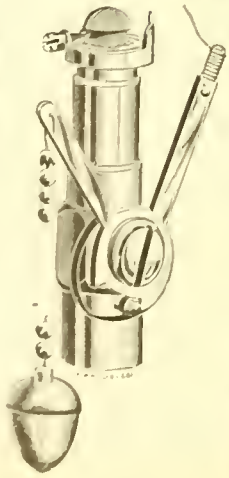


No. 4 Pillar Ratchet Burner.

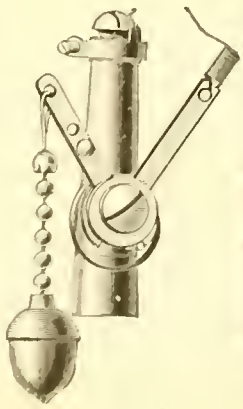


No. 5 Plain Pillar Burner.

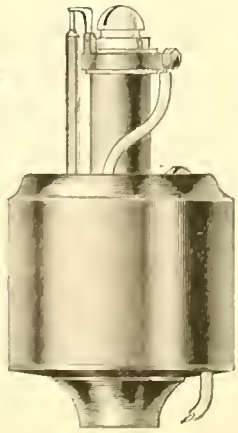
No. 2 Plain Burner.



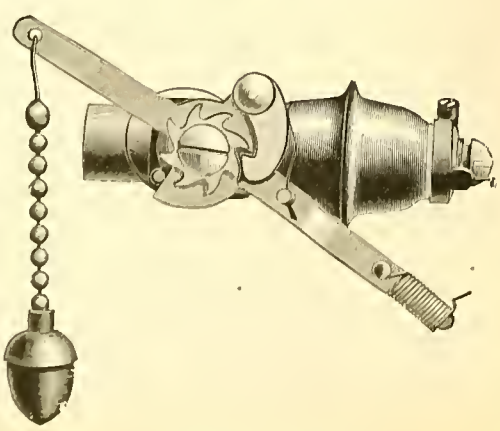
No. 2 1/2 Plain Burner.



Plain Factory Burner.



Vibrator Burner.



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ONLY SUCCESSFUL LAMP FOR INCANDESCENT CIRCUITS,

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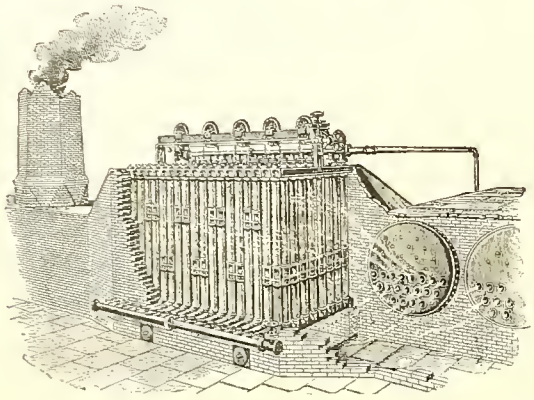

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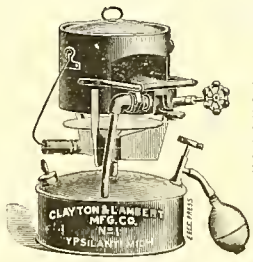

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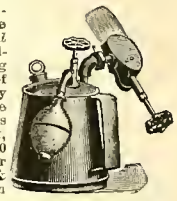

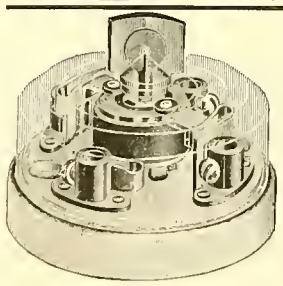

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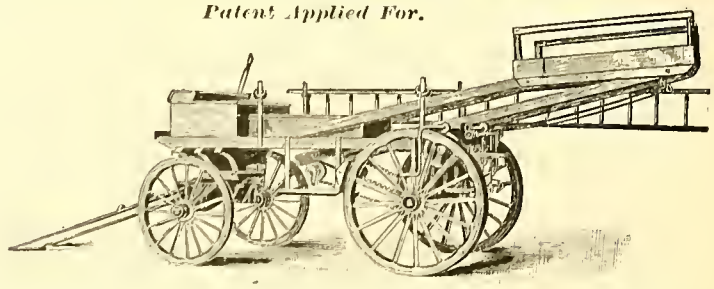

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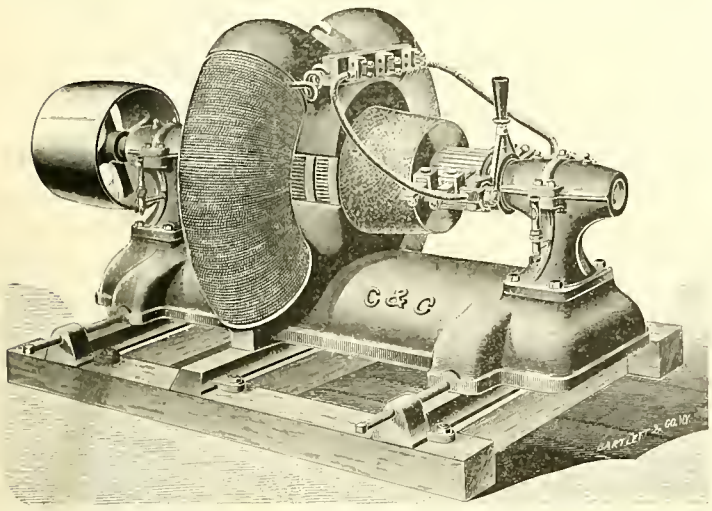

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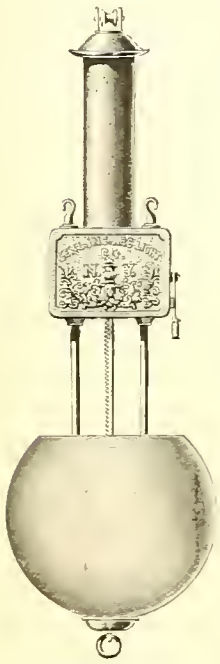

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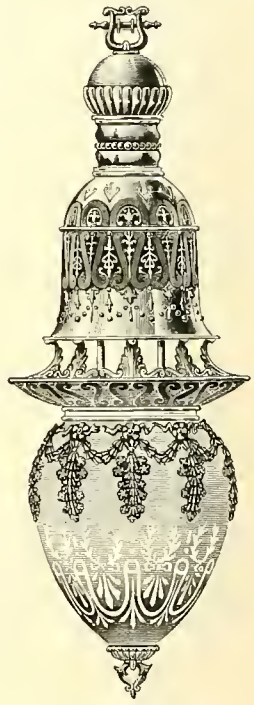

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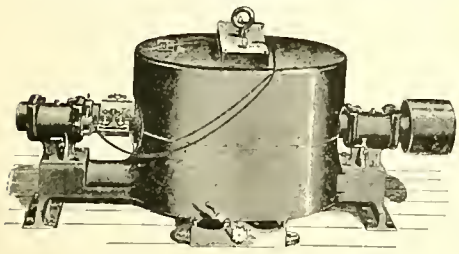

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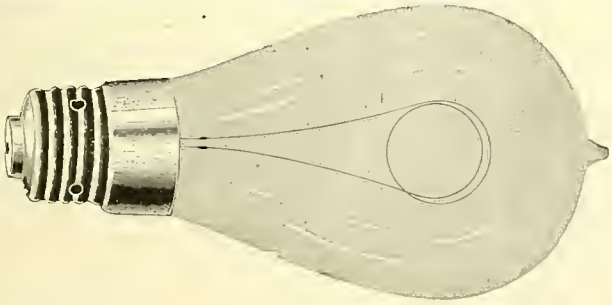

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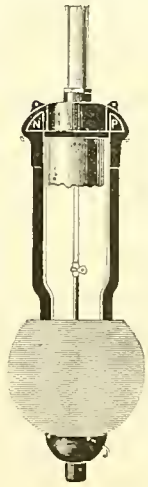

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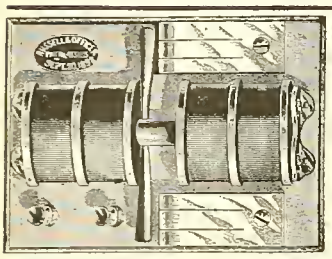

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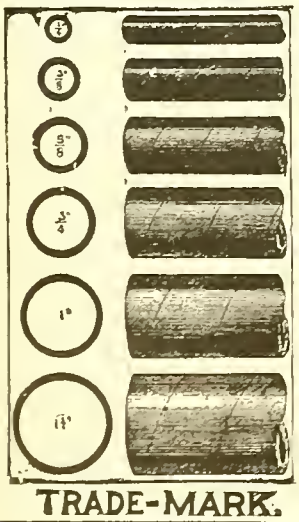

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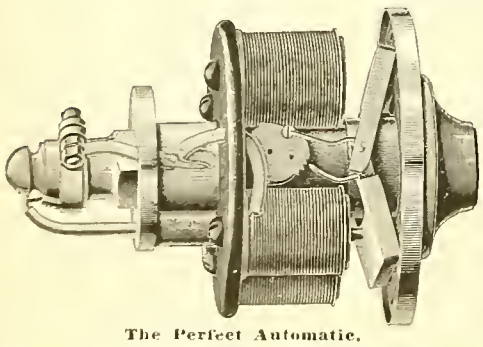

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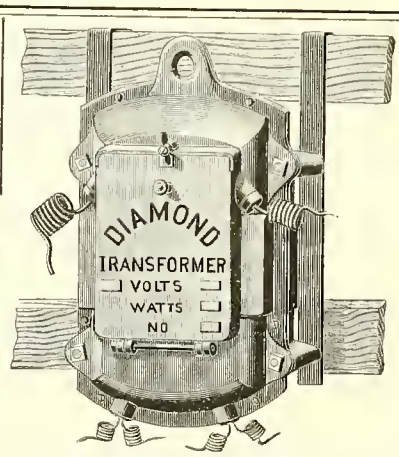

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WORTHINGTON CONDENSERS.

AGGREGATING IN CAPACITY 260,425 Horse Power ARE NOW IN USE.

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BOSTON. PHILADELPHIA. ST. LOUIS. DENVER.

NOTICE.

January 27, 1893.

To the Electrical Trade:

I have this day assigned the entire interest in the Cleveland Switch, Patent No. 391,512, to THE BRYANT ELECTRIC COMPANY, of Bridgeport, Conn., together with the tools, patterns and moulds for making the Switches and Arc Cut-outs formerly manufactured and sold by THE FOREST CITY ELECTRIC WORKS, of Cleveland (Factory, Geneva, Ohio).

I trust that my former friends and patrons will extend to them the same good will and patronage that they have shown me in the past.

Very respectfully, (Signed) W. B. CLEVELAND.

THE BRYANT ELECTRIC CO. MAKES GOOD GOODS.

The WADDELL-ENTZ COMPANY,

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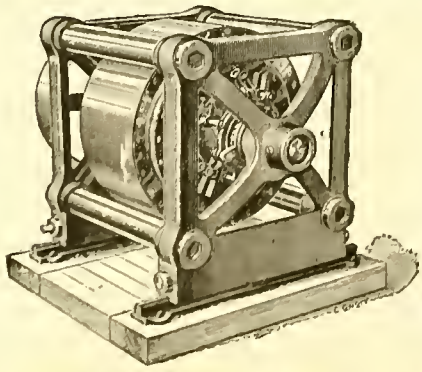

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Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, FEBRUARY 25, 1893. No. 8

Electricity at the World's Fair.

Although the recent severe weather has interfered somewhat with the construction of the electric fountains, yet the work has steadily progressed, and little doubt exists that these attractive features of the exposition will be ready for operation by May 1st. On the northern fountain the wooden deck that will cover the operating space and uphold the two and one-half feet of water in the basin is now finished. Work on the other fountain is not quite so far advanced, as can be seen by a glance at Fig. 1. The excavation for the seven-foot caisson under the basin and the piling are well under way, however, and with milder weather construction operations will be rapidly advanced.

FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.

A view of the northeastern corner of the electricity building is given in Fig. 2. The picture was taken from the opposite side of the lagoon, and the Exposition company's fire-boat is prominently shown.

The interior of electricity building is assuming a more animated aspect every day. The American Bell and Western Electric pavilions are nearing completion, and work on the French exhibit was begun this week. The General Electric company will operate eight arc dynamos of varying sizes in the building for service lighting, and five of these machines have already been received. In addition to these the following named exhibitors have commenced operations in the building:

Ground floor—Eddy Electric Manufacturing company, The E. S. Greeley & Co., Page Belting company, Fort Wayne Electric company, Crocker-Wheeler Electric company, New York Electric Conduit company, Germany.

Galleries—Perry & Rundlett, India Rubber Comb company, Field Engineering company, Weston Electrical Instrument company, Norwich Insulated Wire company, Standard Electric Signal company, Waddell-Entz Electric company, Washburn & Moen Manufacturing company, Billings & Spencer, Hope Electric Appliance company, Roessler & Hasslacher Chemical company, New England Butt company, Utica Electrical Manufacturing & Supply company, F. A. Ringler company, Ford-Washburn Storelectro company, Day's Kerite Insulation company, North American Electric company, K. A. P. Electric Novelty company, National Carbon company, Union Electric company, Standard Underground Cable company, Chicago Electric Wire company of Delaware, Electric Appliance company, T. H. Brady, Waterhouse, Gamble & Co., Ansonia Electric company, Turner D. Bottome, Illinois Alloy company, Queen & Co., Munson Lightning Conductor company, Electric Heat Alarm company, New York Insulated Wire company, H. W. Johns Manufacturing company, C. J. Hirlimann, Gamewell Fire Alarm Telegraph company.

Assistant Chief Hornsby has prepared a list of exhibitors in the electrical department arranged by groups and classes, together with a list of articles shown, which will appear in the first edition of the official catalogue.

A large portion of the incandescent lighting of the electricity building will be done by the General Electric company, which will install one of the latest type of Edison upright triple expansion engines, directly coupled to two Edison multipolar dynamos, in machinery hall for this purpose. The engine is rated at 1,500 horse power, although at the rate of steam pressure adopted by the exposition it will only develop about 1,000 horse power. The dynamos will each be of 400 kilowatts capacity. The foundation for this large lighting set is now completed.

A pretty effect will be obtained by the arc lighting of the large glass dome of the horticultural building. Fifty lamps will be used for this purpose, arranged in three circular rows about the trusses which form the framework of the dome. The lower row will contain 20 lamps, the middle one 20 and the upper 10. This will furnish enough light to make the dome a brilliant object at night.

The work of laying the arc light circuits is progressing rapidly. On Saturday of last week Electrical Engineer Pierce reported that during the last ten days 112,000 feet of wire had been placed in ducts and subways. The agricultural building is now completely wired for arc lights. The contract for the wire for the power circuits has been awarded to the United States Wire & Cable company of Schenectady. This contract calls for 180,000 feet of No. 0000 wire, 19,000 feet of No. 000, 1,200 feet of No. 0, and 24,000 feet of No. 1, B. & S. gauge, rubber covered.

The Westinghouse company has been recommended by the director of works for the contract for supplying two 150 horse power motors for the mines building.

Machinery hall presents a busy scene these days. In the power plant there will be in all 22,000 horse power in boilers and 30,000 horse power in engines. Of the latter 25,000 horse power will be employed to operate dynamos for light or the transmission of power, and 5,000 will drive shafting, pumps, etc. It is worthy of remark that the largest pump has a capacity of 15,000,000 gallons a day—a size equal to that of any pumping engine in the Chicago water works. Nearly all of this machinery is in some stage of unpacking, installation or operation, and the whole constitutes an animated and inspiring panorama. Work on the piping connections between the engines and boilers is now under way, and the two 400 horse power Westinghouse engines now set up will soon be in operation, driving incandescent dynamos. In the German space in this building foundations are being built for Siemens & Halske direct connected engines and dynamos. This firm will supply the arc lighting for the large terminal railway station and for the wooded island.

The electrical newspapers have been allotted space in the northwestern gallery of the electricity building. Each of the principal papers has 196 square feet of space.

The reported dissatisfaction of New York manufacturers has not affected the electrical department to any appreciable extent, despite sensational statements to the contrary.

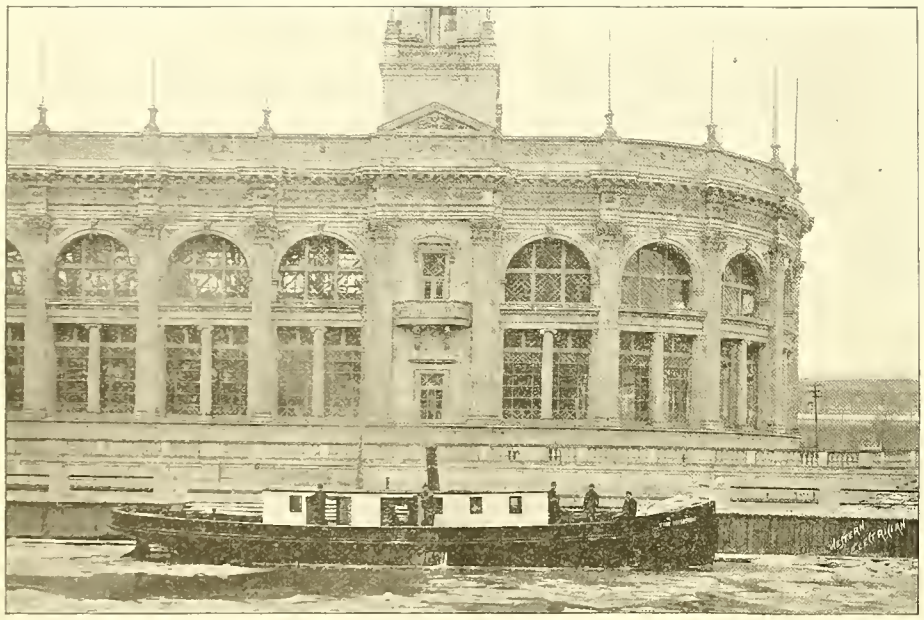


FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.

Mr. Hornsby has prepared a list showing in square feet the amount of space awarded to New York state exhibitors. It is as follows:

C. and C. Electric Motor company, 979; International Conduit & Insulation company, 500; R. T. Brooks, 329; *Electrical World*, 196; Field Engineering company, 464; Empire Gold and Silver Plating Works, 72; Engineering Equipment company, 349; Union Electric company, 344; Thompson & Robertson, 344; Zucker & Leavitt Chemical company, 1,000; Rich Electric Heating company, 500; Standard Paint company, 177; New York Insulated Wire company, 500; The E. S. Greeley & Co., 2,000; Crocker-Wheeler Electric company, 1,105; Roessler & Hasslacher, 75; *Electrical Engineer*, 196; Commercial Cable company, 270; *Electrical Review*, 196; India Rubber Comb company, 100; Bryan company, 375; *Electricity*, 196; Electric Secret Service company, 693, Turner D. Bottome, 200; F. A. Kingler, 72; Norwich Insulated Wire company, 300; C. J. Hirliman, 114; LeClanche Battery company, 72; R. B. Brixey, 340; Standard Electric Signal company, 99; Utica Electric Manufacturing & Supply company, 120; Herwe Iron Works, 500; J. C. Vetter, 72; H. W. Johns Manufacturing company, 1 002; North American Electric company, 50; Excelsior Electric company, 647; Empire China Works, 37.5; *Electric Age*, 196; Manhattan Electric Supply company, 224; Okonite Wire company, 1,496; Granville T. Woods, 90; L. D. Adler, 145; Non-Magnetic Watch company, 100; Sperry Electric Railway company, 500; Electric Conduit company, 500; Waite & Bartlett, 257; General Electric company, 15,000; Thomas A. Edison, 5,000; James H. Mason, 247; Riker Electrical Motor company, 825; A. H. Phelps, 304.

In the description of the arc lighting for the manufactures building which was given in this journal last week it should have been stated that the coronas will be supported from the roof by steel wire ropes ½ inch in diameter. There will be 34 of these cables for the large coronas and 26 for each of the smaller ones.

Two of the Westinghouse company's 10,000 light dynamos are now at Jackson park. These machines have heretofore been described in the WESTERN ELECTRICIAN, but a few additional details will be of interest. Each dynamo consists of two separate rings of field magnets about six inches apart and two armatures carried on the same shaft. Each set of field magnets consists of thirty-six poles of laminated iron, projecting inward from a cast iron ring bolted to the frame of the machine. There are two distinct windings, one for the direct exciting current, from an external source, and the other for the compensating current. The compensating current is obtained by transforming a portion of the main current from the armature by two 20:1 converters fixed to the spider of the armature and then rectifying it by means of a proper commutator carried on the shaft. The armatures are of the pole type, built up of laminated iron stampings bolted together to the required thickness between wrought iron end plates of the same shape. These blocks, which carry one full and two half poles, are then placed in position on the circumference of a cast iron wheel having eighteen T shaped poles and fixed by leading. The armatures are wound after the pattern of the new Westinghouse alternator, by slipping machine wound coils over the poles, pressing them into position and securing them by wedges driven between two adjacent coils. The completed armature is 7½ feet in diameter. The armatures of each double machine are keyed on the shaft with the poles of one opposite the spaces of the other, thus generating a current one-fourth phase ahead of the other. The total weight of the completed machine will be 55 tons, that of the armatures being 21.5 tons. These machines were tested by coupling two of them together, one being run as a generator, the other as a motor by the current from the first; the loss in transmission, hysteresis and friction being supplied by a 300 horse power Westinghouse compound engine.

Funeral of Dr. Norvin Green.

The funeral of Dr. Norvin Green, late president of the Western Union Telegraph company, took place in Louisville, Ky., on the 16th instant, and two services were held, one at the Green mansion and the other at Calvary Episcopal church. The first was rendered necessary on account of the aged widow's feeble condition and her inability to attend the church services. The funeral was wholly devoid of ostentation. Nearly all of the directors of the Western Union and half a hundred division superintendents, chief operators, and others in high authority were present. The floral offerings were numerous and elaborate and were sent from various cities of the Union. Dr. Green's remains were interred privately in Cave Hill cemetery.

Litigation Over Electric Railway Trucks.

Action has been commenced in the United States Circuit Court at Boston, Mass., by the Robinson Radial Car Truck company against the West End Street Railway company for alleged infringement of patents owned by the Robinson Radial Car Truck company. The West End Street Railway company has been using fifty of the Robinson electric radial six-wheeled trucks for several years and is still using them. These it purchased in regular course from the Robinson company. The West End company has also been using a large number of eight-wheeled cars, but it recently determined to equip with radial trucks about one hundred additional car bodies originally built for eight-wheeled equipment. The West End company, it is claimed, without license or authority from the Robinson company, has built and put in operation within the last three or four months about one hundred Robinson electric radial six-wheeled trucks differing from the standard radial only in a few minor details. The Robinson truck has been fully explained and illustrated in the WESTERN ELECTRICIAN.

Fire in the Adams Street Edison Station, Chicago.

About 1:30 P. M. on Thursday of last week fire was discovered in the feeder pit under the engine room of the Adams street station of the Chicago Edison company. The fire was not a serious one, and could have been easily subdued by the employes of the station, but some hare-brained person became frightened by the smoke and sent in an alarm to the fire department. This proved very unfortunate. When the firemen came they were asked not to use water on the feeders until the station could be shut down. They were not to be instructed by any mere electricians, however, and insisted on deluging the distributing cables with water despite the angry remonstrances of the station people. There was instantly a total short-circuit, flames mounting the wall of the engine room, and the entire plant was incapacitated, every light on the company's circuits going out. The firemen had put out the fire, but their remedy was many times worse than the disease, the result of their work being the burning off of the insulation of half the cables for a distance of twenty feet.

Every available man about the station was at once put to work to remedy the damage. The floor of the engine room is of concrete, and this had to be dug up with pick-axes in order that the workmen might get at the feeders. Superintendent Church, Electrical Engineer Ferguson and Construction Superintendent Goehst took charge and worked like beavers. At first the plant was in total darkness, but a station circuit was quickly rigged up, and the men worked by the light thus afforded. When access was gained to the pit the bare spots on the feeders were taped and then the cables were lifted up from the bottom of the moist trench as far as possible and separated from one another by blocks of wood. This was a slow and tedious job. In the meantime the telephone bell was ringing incessantly and the entrance of the station was besieged by impatient customers and a curious crowd. An employe of the company and a big policeman were stationed at the doors, and no one not engaged in the work was allowed to enter the building while the repairs were in progress.

The distributing circuits of the company are so interlaced that current could not be sent out through one feeder alone without a tedious process of cutting out leads at various points in the street mains. This was done, however, to satisfy a few of the imperative demands, and at half past five the lights in the Great Northern hotel were burning and three hours later the circuits supplying the Columbia theatre were in operation. Shortly after midnight the cables were sufficiently repaired and separated for safety. It was necessary to throw the entire load on the station at one instant and thirty men were stationed at the feeder switches in the dynamo room. Each man grasped the handles of two switches, and at a preconcerted signal —the striking of a gong—the switches were closed and 5,000 amperes of current shot through the circuits. This was at 12:20 a. m., less than eleven hours after the station had been totally disabled.

Much inconvenience was caused to users of lamps and motors, of course. The *Abendpost* is printed on presses operated by power transmitted from the Adams street station, and the curren was shut off just as the paper was going to press. The paper was printed on the *Daily News* presses. In the Athenæum building the elevators are operated by electricity, and the short-circuit occurred just as one of the cars, containing several young women, was between two floors. The occupants of the elevator were liberated with some difficulty.

On Thursday the Edison factory at Schenectady was telegraphed to forward 3,000 feet of cable to the Chicago Edison company with the utmost dispatch. Superintendent Kruesi replied by wire that the order would be filled by working night and day and that the cable might be expected by express on Monday. The loss to the Chicago Edison company is believed to be between $5,000 and $6,000. The cause of the original fire is unknown, but it was probably due to defective insulation.

The project has been revived for building an electric railway between Geneva and Waterloo, N. Y.

Questions of Nomenclature.[1]

The necessity for a comparison between the suggestions put forward by the committee of the electrical section of the Royal Commission for the Chicago exhibition and the recommendations of the sub-committee of the American Institute of Electrical Engineers as to the programme for the forthcoming electrical congress is not necessary, since the former were proposed in a very tentative fashion and aimed at little else than a string of ideas from which programme makers might derive assistance. The provisional programme, of which we print an abstract in another column, contains some useful recommendations, and displays a good knowledge of the subjects with which it deals, as well as the needs of the hour. That a set of definitions of physical quantities for international use should be contributed from America to Europe is a sign of the times; and whether the programme be adopted or no, or whether even any congress be held at all, we welcome this report as an interesting landmark in the development of real American science.

The first definition is not well worded. If the impressed electromotive force is the ratio of the electrical activity to the instantaneous value of the current, what happens after the removal of the electromotive force acting in a circuit possessing self-induction? The activity of the circuit is at first unchanged, since the current is not altered instantly, so that, according to the definition, the electromotive force is the same as before. It is true that the dying magnetism supplies the electromotive force needed for maintaining the current, but this is not in any sense impressed upon the circuit, for the circuit itself supplies it. It would have been better to merely reproduce the definition adopted by the board of trade committee for the volt, namely, the potential difference needed to drive a current of one ampere through one ohm.

Some definitions are given of quantities which are at present hardly ever used. Who wants a unit of reluctivity? And, if there be such a person, is he likely to receive any help from the definition that "the reluctivity of a medium at any point is the volume differential of the reluctance thereat?"

With the practical parts of the report we have more sympathy than with the theoretical. Among the terms which are recommended for universal use we are glad, and indeed surprised, to find that no change whatever is needed in the language commonly used in the editorial columns of this journal. "Voltage" is recommended as synonymous with the ponderous pedantry of "difference of electrical potential," with the slovenly "potential," with the slang "P. D.," or the far worse "E. M. F.," with the antiquated "tension," and with the often unscientific but sensible term "pressure." But our experience goes to show that, if only on account of tautology, the term "voltage" will not always suffice. Again, the use of "transformer" for "converter" has for long been our custom, and "dynamotor" for "continuous current transformer" for a necessarily shorter period. "Continuous current" is preferable to "direct current," but this is not a matter of importance.

In the same breath, however, the report recommends the use of "kilowatt" for horse power. This is an altogether different matter, and one to which, if real substitution is intended, we strongly object. For heaven's sake let those who have to employ the term be engineers first and electricians afterwards! We should much prefer to stick to I. H. P., B. H. P., and E. H. P., and let the kilowatt go by the board, if there need be a choice. But there is none; the kilowatt has its uses. While such reforms are going on, we should like to see the affected and pompous term "installation" abandoned. Engineers got on perfectly well with "plant," or "job," or "work" before they were corrupted by the accident of an exhibition at Paris. We find no difficulty in excluding "installation" from our editorial columns.

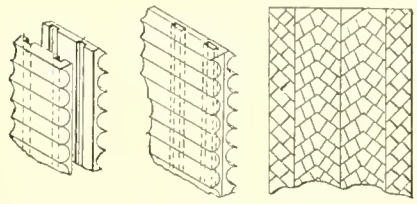
Of the seven names for units which are put forward, a majority stand a good chance of adoption at the congress. The "mho" has been laughed at, but we are probably justified in saying that no one who uses units of conductivity employs any other name; but the same might be said for the use of the name "haf" as the reciprocal of a degree Fahrenheit. The "henry" is sure to be received, for it has been already well tried and only once stood in danger of becoming ridiculous when "milli-hens" and the like were suggested. The "œrsted" for magnetic reluctance and the "gilbert" for magneto-motive force are of rather doubtful value, but we hope that the pair of names, the "gauss" and the "weber," will be respectively adopted for what the report calls "the practical unit of magnetic intensity," presumably B, and for total lines of force or N. The much needed unit of illumination is likely to give rise to some discussion, the "bougie-meter" or the "candle-foot" are open to the objection that all other such compound names imply a product of the components, while in this case the former component is divided by the square of the latter, or is multiplied by the square of its reciprocal. We might then have "candle-toof," "toof" on the "mho" principle, a term accurate enough to satisfy even M. Hospitalier, and hardly more uncouth than "mega-barads," "microholes," and "kilogramme-kines," which have been proposed without apology.

It would not be amiss if the Council of the Institution of Electrical Engineers were to allot an evening or two to a discussion of these proposals, the speakers being kept rigidly to the subject before the meeting, namely, the adoption, rejection, or moderate amendment of America's contributions to international electrical nomenclature. No good can come at this time of day from airy schemes for revolutionizing our system of units, or from fads for increasing this practical unit by one-tenth and decreasing another to the same extent to make it fit. At the close of the debate the council might perhaps reduce the general sense of the meeting to concrete resolutions which might be put to the vote of members only.

1. From the London *Electrician*.

MacLeod's Improvements in Accumulators.

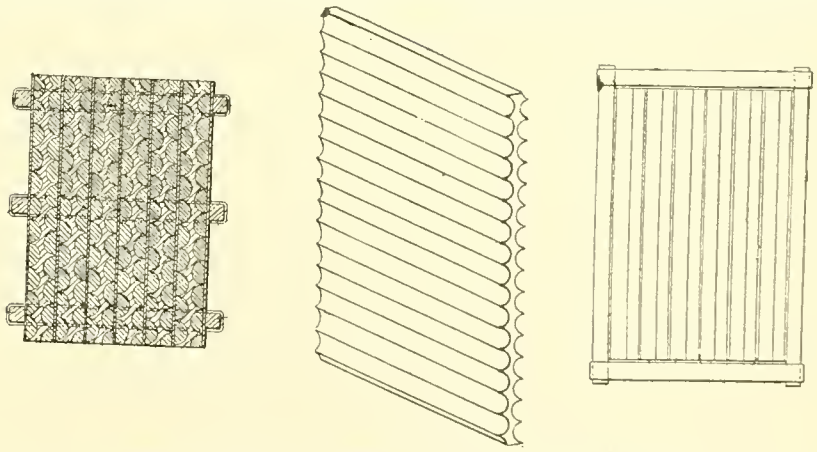
William A. MacLeod of Boston has invented a storage battery in which there are several interesting features. The principal claim for the new battery is that the method of construction aids greatly in the absorption by the porous plates of the electrolyte, so that complete saturation and charging is insured. In the accompanying cuts Fig. 1 is a section showing a cell composed of six of these porous plates and a corresponding number of electrodes. Fig. 2 is a perspective view of one of the porous plates. Fig. 3 is a plan view, showing the method of clamping or securing the plates and electrodes together. Figs. 4, 5 and 6 show modified forms of porous plate. The metallic conducting plates are preferably of lead and may be made very thin. Seven of these electrodes are employed in a cell such as is shown in Fig. 1. Between the electrodes or conducting plates is placed a series of porous plates of earthenware or other acid-resisting material. These plates are provided



FIGS. 4, 5 AND 6. MACLEOD'S IMPROVEMENTS IN ACCUMULATORS.

on either side, if both sides be used, as will commonly be the case, with a number of depressions shown in the accompanying drawings as grooves, the precise shape of the depressions being immaterial. The grooves are preferably formed transversely, but may be vertical when the cell is set up.

The active material of the cell is applied to the porous plate, the depressions being filled with this material. Any active material may be employed, red lead being the material commonly used. When the porous plates are properly supplied with the active material the cell is built up by placing between each porous plate and the adjacent one a conducting plate, and the porous plates are so constructed that the sharply defined projecting parts or ridges of every alternate porous plate will be opposite the depressions of the adjacent porous plate, as shown in Fig. 1. After the cell is built up the plates are clamped securely together, three sets of clamps being employed to each cell, as shown. The pressure of the clamps tends to force the ridges or



FIGS. 1, 2 AND 3. MACLEOD'S IMPROVEMENTS IN ACCUMULATORS.

projections on one of the porous plates into the grooves of the adjacent plate. As the ridges of one porous plate are opposite the grooves of the adjacent plate and the active material as well as the conducting plate is comparatively soft and yielding, the surfaces of the active material may be brought perfectly into contact with the surfaces of the conducting plates. For the purpose of binding the plates, clamps are employed which consist of two strips of rigid acid-resisting material. These are secured at each end by strips of yielding, contractile material, such for example as rubber bands, as such material will withstand the action of the acids used. By this means a clamp is made which presses evenly across the plate, while at the same time the rubber allows the cell to expand or contract during the charge and discharge thereof.

For the purpose of increasing the capacity of the porous plates for holding the electrolyte and insuring a greater supply of electrolyte in the plates when the cell is in use, each plate is made in two parts, as shown, Figs. 4 and 5. These are laid side by side when the cell is built up, forming what is equivalent to a single porous plate [illegible] centrally. As the plates are slightly rough on the surface they cannot be clamped together so tightly as to exclude the passage of the electrolyte, which will be taken up by capillary attraction in the aperture between the portions of the compound plate. If desired, slight grooves or apertures may be formed in the proximate faces of the portions of the plate, as shown in Figs. 4, 5 and 6, so that when the portions are laid together, there will be distinct passages or canals. These passages if desired may be made to branch in different directions between these portions of the plate, as shown in Fig. 6. In this way the amount of electrolyte contained in the plates and between the masses of active material on either side thereof may, if desired, be materially increased, and free movement allowed between the spaces within the plate and the mass of electrolyte outside the plate, which greatly assists in maintaining uniformity of density throughout the whole mass of electrolyte. The absorptive or holding capacity of the porous plates when the latter are not in two parts or halves might be increased by boring or otherwise forming very small apertures or canals in them which would pass in from the edges toward the center, or through the plate from edge to edge.

An Australian Electric Club.

An electric club has been organized in Melbourne, and in commenting on the fact the *Australian Building and Engineering Journal* says: "At the present moment of course it is difficult to say into what the club will develop itself. As a purely social club, it will, we are inclined to believe, be of little practical value to its members; on the other hand the number of scientific members of the club is so very limited that it cannot possibly develop itself into a scientific club for many years to come. However, it does not matter what the club is termed, if it has at heart the practical advancement of electrical engineering in all its branches. Electrical work in Melbourne has so far very little to boast about, and it would be well for all who undertake electrical work in Victoria if the Electric club could bring about a reform in the prices now being paid for all kinds of electrical installation. Unless good work be done we cannot expect to progress, and unless good prices are obtained we cannot expect to obtain good work. Nothing, to our mind, has done more harm to electrical progress in Melbourne than the indifferent work to be found in that city. It is to be hoped that the formation of the electrical club in Victoria will elevate the standard of electrical work to such a point that no fault may be found with it by even the most exacting. We will on some future occasion refer to the matter of electrical clubs again, and also have something to say upon the working of older clubs of this kind, particularly of the Chicago Electric club, which, in spite of its short existence, is one of the recognized electrical clubs in the United States of America."

Elgin Electric Club.

The Elgin Electric club was organized recently, with temporary quarters at 17 River street, Elgin, Ill. Although in existence only four weeks, the prospects for a successful career are unusually promising. The club has already enrolled about sixty members, including the leading electrical men of Elgin. The officers of the club are: President, Fred Purdy; vice-president, Dr. G. L. Marian; treasurer, Henry Klinder; secretary, J. Frank North; librarian, William Hubbard.

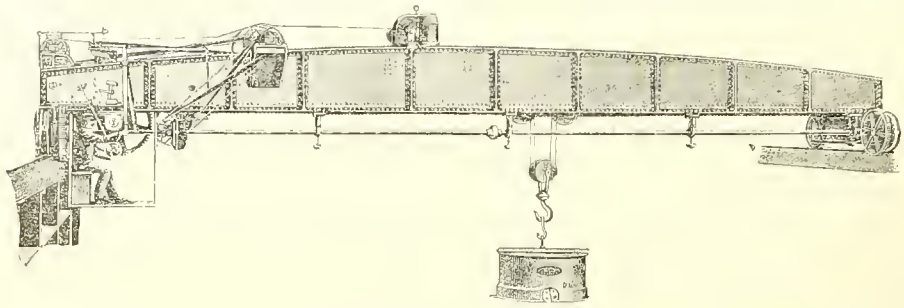
The Stock Yards & Northwestern Railroad company contemplates the construction of a double track elevated road in Kansas City, Kan., and the West Side Electric Railway company is also considering the construction of a double track road about a mile in length.

English Electric Traveling Crane.

In the accompanying illustration is represented a 15 ton electric traveling crane constructed by Thomas Broadbent & Sons, Heddersfield. Two cranes of this style are in use in the maker's shops and are found to be exceedingly useful. The motor man in charge has an unobstructed view from his seat below the main girders, and has complete control of the operation of the crane. All the switch handles are arranged before him, and he can put any part of the gear into operation without taking his eyes off the object which he is raising or lowering. Great economy of time is realized by the provision of six different speeds of lift and lowering, the latter being in each case increased by 50 per cent. over the corresponding lifting speed.

The traveler is driven by a ten horse power electric motor, working at 105 volts, and maintaining under varying loads a constant speed of 750 revolutions per minute. The motor has been specially designed for work of this description by Ernest Scott & Mountain, Newcastle on-Tyne. The armature is of the Gramme type, of large diameter, so that the motor has considerable starting power. The commutator is of extra length, and runs absolutely without sparking, and with practically no wear. The brush-holders are of the makers' improved type, with hold-off catch and tension regulator, and the carbon brushes, when once set, will run for a long time without requiring any attention. The motor is self-contained, the magnets and bearings being mounted upon a sliding bedplate, with tightening screws, enabling the slack of the belt driving on to the main countershaft on the traveler to be taken up when required. The motor is slightly compounded to give starting power, and at the same time it will run under varying loads at a practically constant speed. To start the motor a special switch has been supplied which first of all magnetizes the magnet, then puts the armature in circuit through a resistance, starting the motor slowly. When the motor has got up to about half-speed the switch is moved over a little farther; the armature then runs up to full speed at its maximum power. This type of switch entirely prevents sparking when the motor is started.

The motor is mounted on the top of the main girders, and drives a countershaft by means of a belt, the sizes of the pulleys being so arranged as to give the shaft a speed of 250 revolutions per minute. Upon this shaft there are five pulleys, from which the various motions are driven through belts. The cut is reproduced from *Engineering* of London.



ENGLISH ELECTRIC TRAVELING CRANE.

Electrically Operated Fire Engine.

Many suggestions have been made for the utilization of electricity for the operation of fire engines, and one of the first practical steps toward this application must be credited to an English concern. The accompanying illustrations show a fire engine of this kind and the details of construction. The apparatus was designed by Merryweather & Sons, of London, for use in towns and districts fire brigade; but modified so as to carry a motor and pumps instead of the boiler and machinery of the ordinary steam fire engine. It is intended to be drawn by a pair of horses to fires, and, on arrival, lengths of electric cable, carried on the engine, are attached to the electric light wires, and the pumps can therefore be started in a few seconds, in fact, in less time than the hose connections can be made. Fig. 1 shows the machine pumping water from a portable canvas dam, placed in the street, the dam being supplied with water from street hydrants. The engine can also be used by connecting the suction hose direct to the street hydrant, provided the supply is sufficient. A glance at the detailed drawings, Fig. 2, will show the arrangement of the motor and pump. The equipment is compact and in operation has been proven practical.

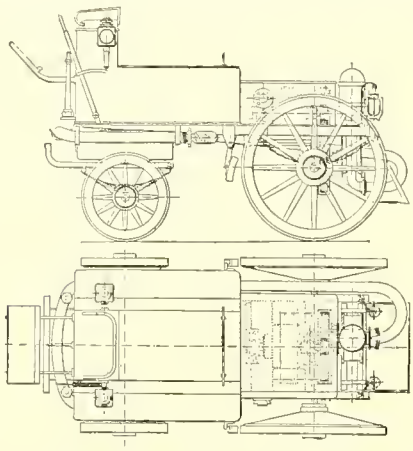


FIG. 2. ELECTRICALLY OPERATED FIRE ENGINE.

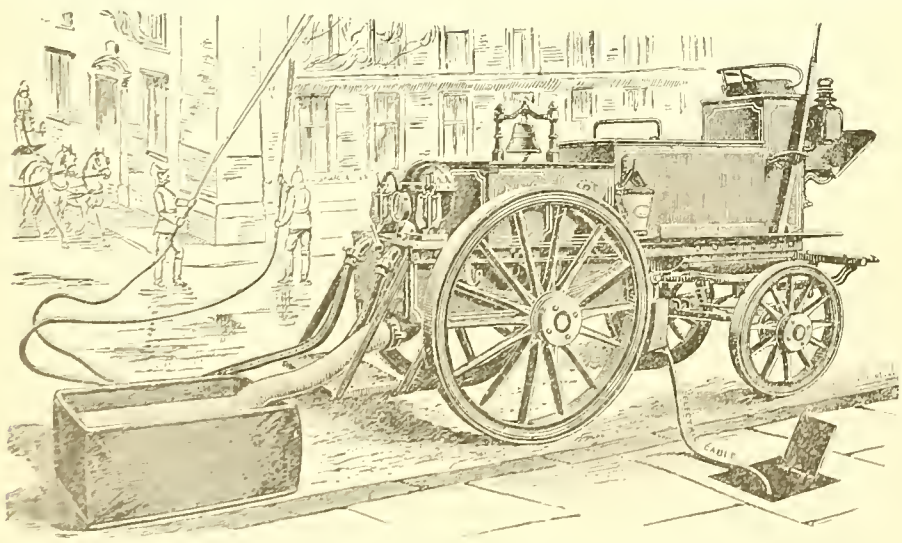


FIG. 1. ELECTRICALLY OPERATED FIRE ENGINE.

lighted by electricity. It is fitted with a Siemens electric motor, driving a pair of Merryweather's special rotary pumps and is capable of throwing 350 to 500 gallons of water per minute, to a height of 170 feet in a single jet, or of throwing as many as four jets to a less height. The pumps are of gun metal, with valves and waterways of the same material, and are fitted with pressure gauges, capacious copper air vessels, and screwed outlets, for the attachment of suction and delivery hoses. The carriage is of the same pattern as that supplied to the Metropolitan

English View of the Lamp Situation.

In an editorial article on the new Westinghouse lamp in particular and the lamp situation in the United States in general the London *Electrical Review* makes some interesting observations. Of the former it says:

The references in this [the Westinghouse company's] statement to the technical points of manufacture are put together in a very oracular manner. The somewhat startling mention of using nitrogen for preserving the carbons, for example, is exceedingly vague. We cannot think that it is seriously proposed to fill the bulbs with nitrogen gas. No one with the least experience in the lamp line, we think, would dream of such a thing nowadays. But there is nothing outrageously absurd in the proceeding of substituting a residual atmosphere of this gas—if it has been found to be beneficial—for the gases given off by the filament during exhaustion. The only point to be advanced against such a plan is the cost and difficulty of first removing the occluded gases from the filaments and then introducing some nitrogen, to be again removed, of course, as completely as possible. There is no hint in the announcement of the employment of such a process, but unless the allusion to nitrogen is a mere blind devised to cause yet another difference to the Edison claims, we can conceive of no other rational explanation for its use.

The particulars as to the value of new, returned and repaired lamps will be read with interest. In commenting on the modified form of lamp not long since in this journal, we gave it as our opinion that new lamps could not be turned out at so low a cost as those of usual construction, and the allowance of 5d. for a returned lamp unbroken certainly confirms this opinion. At outside prices by the sealing-in method, the cost of bulb, platinum and labor does not reach 2½d.; and the deduction to be drawn is that if the company were at liberty to employ the sealing-in method, it could sell lamps for about 1s. each. This is not far from what is rapidly becoming the current price on the European continent, viz., 10d. each. The cost of renewing a worn-out Westinghouse lamp is, therefore, only three halfpence below this price, exclusive of the cost of transport to the works for renewal. In connection with renewing old lamps, it is the company's intention to start "renewal stations" in various large cities, so as to reduce the cost to the consumer of returning worn-out lamps to the central factory.

Provided the lamps are a success in a general sense the remarks anent the policy of running them at a higher efficiency than is economical with those which cannot be renewed, are true enough in strict principle. The consumer would save 2d. or 3d. per lamp after, say, a run of 400 or 500 hours, and, in addition, would obtain either more average light for a given expenditure of current, or spend less on current, and get the same amount of light. But average light and uniform light are not synonymous terms, and a more uniform light (obtained by forcing the lamps less) may perhaps be more valued by some than a rapidly falling light, although its average intensity be greater.

It is stated to be the intention of the Westinghouse company to manufacture these separable lamps at the rate of 15,000 or 20,000 per day, exclusive of renewals. This is no insignificant rate, even when compared with the colossal output of the English Edison-Swan monopolies.

With regard to the attitude of the various Edison illuminating companies that have been started in the states towards the General Electric company, which now controls the Edison patents, it is by no means of a friendly nature. And for this reason: These illuminating companies, who own some three-fourths of the whole incandescent lighting business in America, bought in early days the exclusive right to sell and use Edison lamps in their respective territories, and in return for the privilege assigned to the Edison company a portion of their respective stocks. Infringing companies next spring up, and sell electric lighting apparatus within their domains, without let or hindrance, and at a cheaper rate than the original illuminating companies had to pay the parent company for their supplies. It thus happened that the Edison licensees have not made the amount of profit they had a right to make. Hence the unfriendly spirit towards the Edison Electric company; and the animosity is greater still against the General Electric company, since many of their bitterest rivals (which have been from time to time absorbed by the Thomson-Houston company) are now affiliated with the Edison combination. By way of retaliation they have now the power to say, "We will not allow you to sell any lamps in our territory; and we ourselves will not sell lamps to any of our customers except at a price we may fix upon. And further, we refuse to sell lamps at all to our rivals—the Thomson-Houston, Brush, Fort Wayne, Jenny, etc." Nor is this all; for prior to the amalgamation of Edison with Thomson-Houston, the latter had guaranteed its licensees against liability for possible infringement of the Edison patent; so that should these rival lighting companies now be unable to obtain lamps in consequence of action on the part of the Edison licensees, they have the right to sue the General Electric company for damages. Thus all these circumstances combine to place the General Electric company in a very awkward position, and it seems questionable whether it will derive much benefit from the recent victory it has gained in the law courts. It is not surprising to learn that the embarrassed situation is having a very detrimental influence on the trade just at present, but hopes are entertained that before very long important developments in the direction of relieving the situation will be arrived at.

The Union Electric Street Railway company has been incorporated to construct a line from Drifton to Lehigh, Pa.

Experiments With Electric Waves.

By one of the greatest syntheses that the scientific century has produced Maxwell presented irrefutable proofs that the velocity of light was the same as that of electric dynamic action. He concluded from this that the two phenomena are propagated by a similar movement in the same medium, i. e., the ether, and that the luminous waves only differed in point of rapidity from the oscillations which cause electro-dynamic induction. But Maxwell's demonstrations were contained in elaborate formulæ, and were little comprehended outside of the world of the professional physicists. There was needed a popular and tangible proof, and that is what Prof. Hertz of Bonn University has discovered. The wonderful means which he devised has opened a field in which physicists have worked and will continue to work. Sarasin and La Rive were the first to improve upon the methods of Hertz.

A certain insight into the experiments can be gained by referring to water as an analogue. If the water level is disturbed in two receptacles placed at the same level and connected by a large tube, it will be re-established by a series of oscillations. If the tube be compressed the level returns after a slow and asymptotic movement of the fluid. Thus it is in the experiments. In an apparatus composed of two small spheres separated by a slight distance, an electric discharge passing from one ball to the other will be asymptotic in certain conditions of capacity and effective resistance, and will be in other cases oscillatory.

When the oscillations reach some hundreds of millions per second, the inductive effects become pronounced, and the action, being propagated at a speed of 186,000 miles per second, produces in the space strice of tension analogous to sound waves in the air or in some other medium. These waves are not propagated in the conductors; they glide along their surface when they are tangent to them, or they are reflected when they intersect them. They can, like sound waves, produce loops and fixed nodes if they are reflected.

At the commencement of his investigations Hertz believed he had found that the waves traveling in the conductors attained a speed which was only six-teaths that of light. He announced this result only as provisional and uncertain. This belief was invalidated by the first experiments of Sarasin and La Rive. But these conscientious and skilful observers did not stop there, feeling that the limited dimensions of their laboratory might prejudice the result they took down the partitions and tried the experiment again, without reaching a different conclusion. Finally, at the request of Prof. Hertz himself, they determined to operate on a larger scale, and they removed their apparatus to the turbine room in one of the power stations on the Rhone.

The accompanying illustration shows the extensive character of the installation. The oscillator which produces the rapid succession of sparks is shown at the right. Electro-dynamic action propagated in all directions strikes at a distance of about 50 feet a zinc mirror 24 feet in height and 52 feet in width.

Waves reflected from the mirror interfere with the direct waves coming from the oscillator, and as a result of the interference nodes and loops are produced. Nodes may be described as points at which there is no electrical vibration while maximum, vibration is found at the loops. To ascertain this a test ring, which is made of wire bent in the form of a hoop, with the ends slightly separated, is held at the nodes, and no result is noticed, but in the loops a stream of sparks passes across the gap in the hoop. In order that the experiment might be conducted in darkness the long box or tunnel was constructed.

As the point midway between the nodes can be determined by means of the test ring, the length of the wave can be easily ascertained. The number of oscillations per second which produced the action in the test ring or resonator can be calculated. This number multiplied by the wave length gave the speed of the electro-dynamic action. This presupposes, of course, that no error in reasoning has been committed, but physicists are not entirely agreed on that point.

Taking this for granted, Sarasin and La Rive found in their extensive installation the identical result that they observed when experimenting on a smaller scale; i. e., the speed of propagation of electro-dynamic action in free air was the same as along wires, that is to say, upon the surface and not inside, where they are not propagated at all. By the method which has been briefly sketched, Blondot has proved in a direct manner that this speed, allowing for errors in the experiments, was the same as that of light.

But experiment has not stopped here. The speed of the propagation of waves in different media has been studied, and the results are very interesting. Cohn has proved, for example, that the speed in water is 8.5 times less than in air, and this is precisely the value of the index of refraction of water for electric waves found by Ellinger. The square of this number, 72, is very near the apparently paradoxical value found by a great number of observers for the dielectric constant (specific inductive capacity) of water. The index of refraction of alcohol, 4 9, leads to the same confirmation.

No one would have dared to hope, ten years ago, that Maxwell's idea in so short a time would be so strikingly and beautifully proved. The illustration is reproduced from *La Nature*.

National Electric Light Association.

Western members of the National Electric Light association are alive to the importance of the meeting at St. Louis February 28th, and there is no doubt but that there will be an unusually large attendance. Chicago interests will be well represented. Arrangements have been made with the Illinois Central Railroad company for reduced rates. This is the first time in many years that the Chicago members have been granted a special rate, and this inducement, especially in view of the fact that the convention will be held so near home, will undoubtedly tend to make the Chicago party much larger than it has been for several years. Through the efforts of Jesse Scribner special accommodations, as well as special rates, have been secured, and these are fully explained in the following statement which Mr. Scribner has issued for the information of members:

For the benefit of those desiring to attend the National Electric Light association convention at St. Louis February 28th and March 1st and 2d, arrangements have been made for a rate of a fare and a third for the round trip ($10) on the certificate plan. The Chicago delegates will leave by the Illinois Central at 9 P. M. February 27th, arriving in St. Louis at 7.20 A. M. the next day. The regular equipment of this train (the Diamond Special) includes a magnificent new ten compartment Pullman, with double upper and lower berths, closets, gas, etc., especially adapted for those members who will be accompanied by their wives, and a new sleeper finely finished. The price of berths is $2 and compartments $4. A buffet will also be accessible. The train can be met at either Lake, Van Buren, Twenty-second, Thirty-ninth streets, or Hyde Park stations.

If members desiring accommodations reserved will advise me by telegraph at the earliest moment, stating whether they wish berth, section or compartment, I will see that they are provided for.

Tickets may be secured at the Illinois Central office, 194 Clark street and stations mentioned except Van Buren street. Delegates will purchase a ticket one way, state that they are going to attend the convention, and the agent will give them, in addition to the ticket, a certificate of such purchase. On arriving at St. Louis they will leave the certificate with C. O. Baker, Jr., at the office of the secretary of the National Electric Light association, who will indorse it and return it as soon as possible. This certificate, when so indorsed, upon presentation at the Vandalia Line ticket office in St. Louis, will entitle the holder to purchase a return ticket at one-third the regular fare. This matter of having the certificate properly indorsed is absolutely necessary in order to get the return ticket at the reduced rate.

Sleeping car accommodations for the return trip can be arranged for with a representative of the Illinois Central, who will accompany the party on the way down.

Following is the official programme of the convention issued by the secretary. The sessions of the convention will be held at the Bell Telephone building:

TUESDAY, FEBRUARY 28TH.

Meeting of the executive committee at 9 o'clock, parlor, Southern hotel.

Morning Session, 10:30 o'clock.

Address of Welcome, Hon. E. A. Noonan, Mayor of St. Louis.
Address, President James I. Ayer.
Report, Committee on Data.

Afternoon Session, 2 o'clock.

Report, Committee on Safe Wiring.
Report, Committee on World's Columbian Exposition.
Paper, A. D. Adams, "Wrought versus Cast Iron for Field Magnet Frames."

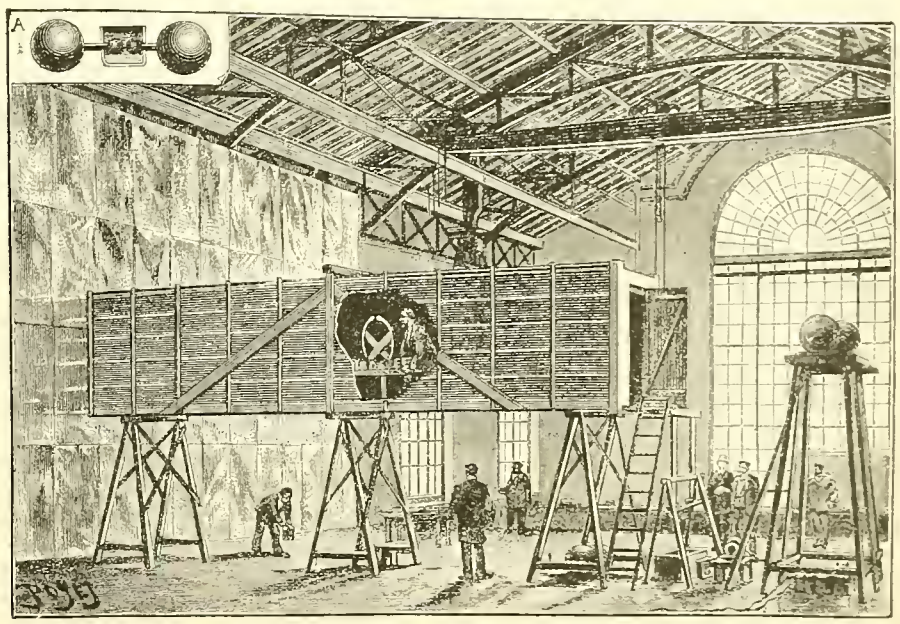
WEDNESDAY, MARCH 1ST.

Morning Session, 10 o'clock.

Paper, H. C. Meyers, "Preservation of Poles and Cross Arms."
Paper, Chas. S. Bradley, "Long Distance Transmission of Power."
Paper, L. B. Stillwell, "Under What Conditions Is the Use of Water Power Economical?"

Afternoon Session, 2:30 o'clock.

Paper, E. A. Armstrong, "Morals of Corporations."
Paper, R. H. Sterling, "Some Experiences with the Alternating System."
Paper, William Brophy, "Relation of Insurance to Electric Lighting and Power."



EXPERIMENTS WITH ELECTRIC WAVES.

Evening Session, 8 o'clock.

Lecture by Nikola Tesla.

THURSDAY, MARCH 2D.

Morning Session, 10 o'clock.

Paper, W. H. Browne, "Underground Conduits and Conductors."
Paper, Calvert Townley, "Incandescent Lamp from a Commercial Standpoint."
Paper, Louis Bell, Subject to be announced.

Executive Session.

Report, Secretary and Treasurer.
Election of Officers.

The committee of the St. Louis Electric club has adopted the following programme, subject to some change in detail later:

MONDAY.

Afternoon.—Special committee to meet incoming Vandalia train at East St. Louis, or farther out, if possible.
Evening.—Reception committee at Union depot and all hotels. Informal reception at Electric club rooms.

TUESDAY.

Evening.—Visits in carriages to the Missouri, Municipal, and Union Depot electric plants.

WEDNESDAY.

Afternoon.—Theater party for the ladies accompanying delegates.
Evening.—Tesla lecture. Reception immediately afterward.

THURSDAY.

Afternoon.—Carriage drive for ladies through West End, Tower Grove park and Shaw's garden.
Evening.—Theater parties for delegates and ladies.

FRIDAY.

Morning.—Meet at Electric club rooms at 10:30, take suburban electric cars to DeHodiamont; inspect power station; proceed out suburban road to Ramona lake; thence return by Union avenue branch to Forest park; take carriages to Jockey club at Fair grounds for lunch. Return, if time will permit, via Benton-Pellefontaine railway station, reaching hotels at 5:30.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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"CASTLES in Spain" have always been held to be the abodes of indolence and ease, and it seems that an elegant leisure of similar nature characterizes the construction of electric railways in that country. A franchise for an underground electric line in Madrid has been granted to one Don Pedro Garcia Faria. It is stated that the road is to be made up of four sections, and only a single short stretch is to be above the surface, and for that a viaduct is to be used. Construction work is to be commenced within a year. Eight years are to be allowed for completing the electric water power plant and the first section of the line, and four years are to be allowed for building each of the remaining sections, making twenty years in all. But although the Spaniards are a little slow, the present indications are that they can use up their entire time allotment and still easily antedate the realization of a rapid transit scheme for New York.

CHICAGO has an excellent fire department and one of which the citizens are justly proud. But Chief Swenie should teach his men that there is such a thing as being over-zealous, especially in fires where wires carrying currents of electricity are involved. An instance of this misplaced energy occurred at the fire in the Chicago Edison company's station last week. Originally the fire was of no great consequence, but the firemen rushed in, laid three lines of hose and saturated the distributing feeders with water. The entire station was instantly short-circuited and there was a great display of fire-works. The result was that the plant was shut down for eleven hours and thousands of persons were put to great inconvenience for lack of light and power. This state of affairs was directly chargeable to the firemen, who were begged not to turn on the water until the station could be shut down. If the firemen had heeded this request, the plant could have been shut down, the fire extinguished, temporary repairs made to the insulation and the engines started up again in half an hour. The ignorance and bull-headedness shown by the firemen in this case is exasperating, and the chief should make it his duty to see that his men have a few elementary lessons on the effect of water on live wires.

QUITE a change is noticeable of late in the attitude of insurance companies toward electrical interests. While the underwriters are not less vigilant in their efforts to keep up a high standard of construction, they do not display the opposition to electric lighting that formerly marked their policy. This can only be explained by the fact that they are beginning to realize the advantages of the electric light over other forms of illumination in the matter of safety. They are certainly justified in this change of policy if statistics have any value. Official reports of chiefs of fire departments in 82 cities of this country having a population of 20,000 or over show that during the year 1891 there were 18,118 fires from all causes, only 225 of which were attributed to electric lighting and power circuits. A comparison of the losses is equally interesting. The total value of property destroyed in all the fires reported was $21,357,539.95, while only $216,899.75 could be charged to the fires caused by electric currents. This is certainly an excellent showing and one that will appeal to every business man. It has always been claimed by the advocates of electric light and power that with proper construction the fire risk would be reduced to a minimum where electricity was employed. And now they are supported in this position by official statistics, compiled from reports prepared by disinterested persons.

IT is gratifying to record the fact that the electrical department at the World's Fair promises to be the first to have a completed display to offer for public inspection. Mr. Hornsby, the assistant chief, has shown commendable energy in pushing the work of the department, and the exhibitors are cordially seconding his efforts, as shown by the list of those who are now making preparations in the building, published on another page. There was considerable vexatious delay in the construction of the building, but the contractors have largely atoned for this fault by turning over a structure that has proved to be one of the best constructed on the grounds. During the heavy snowfall of this winter the glass roof of the building has withstood the strain admirably, which is more than can be said of most of the other buildings. Exhibitors have therefore no fear that their goods will be injured, and all seem imbued with the necessary spirit of activity. In machinery hall the prospects for the completion of the service plant by May 1st are not quite so bright, but this is no fault of the mechanical and electrical engineering department, but is solely due to delay on the building and differences of opinion among those high in authority. These drawbacks have now been overcome, however, except in the case of the litigation over the boiler plant, and henceforth every nerve will be strained to complete the work. It is hoped that the entire plant will be in operation by the opening day, but in any event it will be so near completion that the service of the exposition will not be seriously impeded.

THOSE who have carefully followed the course of the lamp litigation will not be surprised to learn the decision of Judge Colt of Boston in the case of the Beacon company. In granting the injunction applied for by the Edison company the court took the only course that could be consistently followed. In his decision the judge said: "It has often been laid down that a meritorious invention is not to be defeated by something which rests in speculation or experiment or which is rudimentary or incomplete. The law requires not conjecture, but certainty. It is easy, after an important invention has gone into public use, for persons to come forward with claims that they invented the same thing years before, and to endeavor to establish this by the recollection of witnesses as to events long past. Such evidence is to be received with great caution, and the presumption of novelty arising from the grant of the patent is not to be overcome except upon the most clear and convincing proof." It may be added that much more importance has been given the Goebel claims at the present time than they could possibly command under almost any other circumstances. The importance of this proceeding has been greatly magnified, and the impression has been created that failure would be almost a death-blow to the incandescent lighting business. The decision of the court in a recent case in Chicago does not support this view. On the contrary it clearly indicates that the demand for incandescent lamps must be supplied at a reasonable price, and that if the facilities of the Edison factories are so limited that this cannot be done the injunctions now resting upon rival companies will be removed. In the meantime there is no reason to believe that the dynamo builders will be seriously affected by this decision.

A SUMMARY of the complaint filed by the attorney-general in the action instituted by the government against the American Bell Telephone company to annul the Berliner patent is presented elsewhere in this issue. The principal grounds upon which the action is based are that the patent issued was for an invention that was not covered by the original application filed by Berliner; that the introduction of the amended specification, claims and drawings should not have been allowed by the examiner of patents; that the amendment related to an invention not covered by the original application, but for an entirely different invention, and that its incorporation in the application was secured by fraud and with the object of deceiving the patent examiner; that the apparatus covered by this amendment was not invented by Berliner and that it was in common use for more than two years prior to the filing of the amended application; that the telephone company which had secured control of the application not only failed to press the claims of the inventor and secure an early issuance of the patent, but pursued a dilatory policy and contributed to the delay by causing other applications which it controlled to be placed in interference with it and by this course succeeded in having the issuance of the patent delayed until the term of the original Bell patent was about to expire.

Owing to the fact that the examiners in the patent office were not familiar with the art of telephony, it is explained, the deception was not discovered for some time, and then the telephone company set up the claim that it was too late for the patent office to consider this phase of the case. This plan, according to the complaint, was pursued until the company finally secured the patent. There are many questions of law and fact involved in the case, and the proceedings will be watched with interest.

IN common with all others interested, the members of the electrical fraternity desire that the greatest care be exercised in the selection of the judges who are to pass upon the comparative merits of the exhibits at the World's Fair. Perhaps it would be just as well if the whole system of awards were done away with, but if we must have it the judges must be well qualified by ability and experience and absolutely impartial. The appointment of judges is now under consideration, as we learn from a circular letter from John Boyd Thacher of Albany, N. Y., chairman of the executive committee on awards, who gives the following particulars:

The rules provide among other things that each exhibit shall be examined by an individual judge, who must be so far as possible a competent expert and must formulate his opinion of an exhibit in writing and sign his name thereto, and that this report must receive the confirmation of the department committee of which he is a member. There are thirteen of these departmental committees, one of which is assigned to each of the thirteen great departments of the exposition, and these thirteen committees compose the board of judges. There will be foreign representation upon each of these thirteen committees, and also one or more women judges upon all committees authorized to award prizes for exhibits which may be produced in whole or in part by female labor. It is the desire of the World's Columbian Commission to compensate judges, but this will depend upon the action of congress, to which application has been made for an appropriation sufficient to defray all expenses connected with this subject of awards. Should the appropriation be made, judges from the United States will receive $600 each, and those from foreign countries $1,000 each. Their work should begin June 1st and last about two months. The management of this whole matter is in the hands of the executive committee on awards, which is receiving applications for appointments as judges at its temporary office in the capitol at Albany. After March 15th the office will be permanently established in the administration building of the World's Columbian Commission, at Jackson Park, Chicago.

Mr. Thacher does not state the number of members in each committee or the proportion of foreign representatives. In the case of the electrical department it will be necessary to select men not affiliated with the great manufacturing companies which exert so marked an influence on the business. We have in mind one man who could serve on the committee very acceptably as one of the western members. That man is Prof. H. S. Carhart of the University of Michigan at Ann Arbor. He would make a good judge.

Berliner Telephone Litigation.

As announced in the last issue of the WESTERN ELECTRICIAN the attorney-general has begun an action against the American Bell Telephone company to annul the patent issued to Emile Berliner, November 17, 1891. In the complaint the attorney-general reviews the proceedings in the prosecution of Berliner's claims before the patent commissioner and points out the effect which this patent, if permitted to stand, would have upon the telephone business of the country. It is contended by the complainant that the patent issued to Berliner is not for the invention described by him in his application filed June 4, 1877, but for an entirely different invention. It is asserted that on September 1, 1880, Anthony Pollok, solicitor for the telephone company which had purchased the invention, "amended the application by striking out all the drawings then on file and substituting new ones, and striking out the entire specification except the preamble and signature, and substituting a new specification and claims, which was not, however, signed or sworn to by Berliner or verified under oath until long afterward." Commenting upon this proceeding the complainant says:

This amended specification was drawn with consummate art, and with intent, as your orator believes and charges, to mislead and deceive the examiner of the patent office by concealing from him the fact that the amendment introduced into the application a new and substantive invention not found in the original application.

Another point raised by the attorney-general is that after securing control of the invention of Berliner, the telephone company pursued a dilatory course in order to delay issuance of the patent until Bell's original patent was about to expire, and thereby to gain an extension of the monopoly of the telephone business in this country which it had enjoyed under patents enforced and protected by the government. In pursuance of this policy it is claimed that two interferences were declared in the patent office between the Berliner application and the Bell patent, that these interferences remained pending until September 30, 1880, when the telephone company caused Berliner to file in each of them a written concession of priority of invention to Bell, thereby terminating the interferences. Other cases of a similar nature are cited to show that interferences were declared merely to delay the granting of the patent. One of these is particularly interesting as illustrating the methods which the attorney-general alleges were employed by the telephone company throughout the proceedings. It appears from the complaint, that after filing his application, Berliner introduced by amendment a feature of construction, consisting of a contact plate or piece of carbon attached to or forming one of the electrodes of the apparatus, which was an element of invention not found in the original application, as filed, and which he could not lawfully insert as an amendment. But the examiner in charge, not perceiving that fact, on March 26, 1878, declared an interference upon that point between Berliner and Edison. On September 3, 1880, by stipulation the interference was suspended and the papers returned to the primary examiner. This interference remained as a suspended but undetermined proceeding until October 21, 1891, when it was dissolved by the examiner of interferences. It is charged that the inventions of Berliner and Edison were owned by the the telephone company and that the proceedings referred to were continued merely to keep the Berliner application in the patent office. But for the policy designedly pursued by the telephone company the patent "might and would have been issued before the middle of the year 1880." Furthermore it is claimed that during the pendency of the application the company suffered it to rest without action and failed to prosecute from October 23, 1883, to February 19, 1886—a period of more than two years, whereby the application was abandoned, and all further action on the same by the commissioner of patents and his subordinates was unauthorized and void.

Concerning the value of Berliner's invention it may be said that the attorney general disputes his right to a patent. He asserts:

It is against justice and equity and contrary to the plain spirit and intent of the patent laws, that the monopoly of one and the same invention shall be prolonged in one and the same person by the grant, first, of a patent, or patents, for the invention in practical and applied form, and afterward of a patent covering nakedly and broadly the fundamental principle of the same invention. And pointing out the circumstance, which appears from the facts already stated, that from the time of acquiring title to the invention of Berliner, until the issue of patent 463 569, the telephone company had control of the application of Berliner, and at the same time owned the inventions and patents of Blake, Berliner, and others, under which it was enjoying a monopoly of the use of the broad invention of the constant contact telephonic transmitter, the complainant avers that there rested upon the company an extraordinary duty to speed application by every means known to the law, and that if by any act or omission of the company the issue of patent 463,569 was to any extent delayed beyond the date when it might have been issued if it could of right be issued at all), such delay ought to and does invalidate the patent.

In the Bell patent 174,465, an apparatus was described by means of which sonorous vibrations of the atmosphere may be caused to produce corresponding undulations in an electrical current. This apparatus consisted of an electromagnet in the conducting circuit, and an armature placed in front of one of the poles of the magnet capable of being vibrated by the action of sound waves, which vibration, operating by induction through the electro-magnet, causes corresponding undulations in the electric current. It was also stated in the patent that other means, and among them variations of resistance in the conducting circuit, might be employed to produce undulations of current.

In patent 463,569, as issued, there is described and claimed an apparatus for causing sonorous vibrations of the atmosphere to produce corresponding undulations in an electric current which consists of two electrodes placed in contact, one of which is free to vibrate in response to the action of sound waves in such manner as to vary the pressure of the contact between the electrodes without breaking the same. The principle upon which such an apparatus operates is as follows: The discontinuity of conducting material at the point of contact between the electrodes creates a resistance to the flow of current, which resistance is increased by lightness or weakness of pressure between the electrodes, and decreased by closeness or force of such pressure; by increase of resistance in this manner, the electric current flowing in the circuit is weakened, and by decrease of resistance it is strengthened; hence, movements of the vibrating electrode produce, first, variations of pressure between the electrodes; these, in turn, produce variations of resistance in the circuit; and these again, corresponding variations of current, by means of which succession of actions sonorous vibrations of the air are made to produce corresponding undulations of current in the circuit.

Patent 463,569 contains six claims, in four of which, the first, second, third and sixth, and each of them, there is found as a constituent element of the combination the feature of constant contact during operation between the electrodes in the circuit. But there is not found in the specification of this patent any description of any form or construction of mechanism in itself requiring invention for the purpose of making, adjusting, or operating the apparatus in such manner that constant contact between the electrodes may be secured and maintained in use.

In the original application filed by Berliner there was described an apparatus comprising two electrodes, one of which consisted of a vibrating diaphragm, and the other of which consisted of two adjustable contact pins, one of which pins was placed initially in contact with one side of the diaphragm, and the other on the other side of the diaphragm, not in contact therewith, but within the field of its vibration. And in the operation of this device as described in the application, the diaphragm in its vibration caused by the impact of sound waves upon it remained in contact with said first-mentioned pin, or made and broke contact therewith, or made and broke contact with both pins alternately, according to the extent of its range of movement.

But there was not described in the application any apparatus operating or designed to operate with constant contact between its electrodes. And in the claims of the application no claim was made of any apparatus operating or constructed or designed to operate with constant contact. Figs. 1 and 2, which appear in the patent as issued, and all the matter found from line 7 to line 63 of page 1, inclusive, of the specification, and claims 1, 2, 3 and 6, were, it is charged, all added to and inserted in the application by amendment after its filing, and after the assignment from Berliner to the respondent company or its assignor, so that it is claimed patent 463 569, as to all its broad claims, is for an invention which was not shown or described in the application as filed, and is for a different invention.

The failure of the patent examiners to discover the alleged deception practiced upon them by the introduction of the amendment to the specifications and the substitution of new drawings and claims, and the importance of these changes, is explained by the fact that telephones had not come into general use at the time, and that technical knowledge of the art was in a great measure confined to the experts of the telephone company. It is admitted that the examiners were ignorant of the true function, value and importance of the feature of constant contact between the electrodes of a telephone transmitter. Continuing the complainant says:

While it can be seen plainly now that the object of the amendment was to introduce into the application and claims broadly the element of constant contact between the electrodes in a telephonic transmitter, the same was studiously framed in such manner as to conceal from the examiner the fact that the amendment involved a departure from the original application.

While in the drawings as filed the two electrodes of the device are represented as in contact, there was nothing in the drawings to indicate whether the vibration of the diaphragm in operation would break that contact or not. And while in the description contained in the specification it was directed that the electrodes should be placed in contact initially, and was stated that they could operate by varying pressure, there was no statement that they must be so constructed and adjusted as to remain in constant contact, and no description of any manner of constructing, adjusting, or operating the apparatus by which the result of constant contact during operation could be secured, and no statement of any necessity, importance, or usefulness of constant contact between the electrodes except this, viz: "If the uttered sound is so strong that its vibrations will cause a breaking of the current at the point of contact in the transmitter, then the result in the receiving instrument will be a tone much louder, but not as distinct in regard to articulation," which is a deceptive and misleading statement, because the truth is, as was well known then to the respondent company, its expert employes and its solicitor, that articulated sounds cannot be transmitted at all by make and-break contacts of the electrodes.

To such extent was this studied concealment of the real invention which it was sought to cover by substituted specification carried that it has invalidated patent 463,569, which, as issued, contains the descriptive matter of the substituted specification without substantial change, and because the patent does not contain any description of the invention and of the manner and process of making, constructing, and using it in such full, clear, concise and exact terms as to enable any person skilled in the art to which it appertains or with which it is most nearly connected to make, construct and use the same, and does not explain the principle thereof and the best mode in which the patentee contemplated applying that principle so as to distinguish it from other inventions.

If the substituted specifications of September 1, 1880, had contained a full and clear description of the construction, operation, use and functions of the element of constant contact between the electrodes of a telephonic transmitter, the examiner would have perceived at once the departure of the substituted specification from the original application, and the main question of the applicant's right to bring in that matter by amendment would have arisen at once, and, however the same might have been decided, it could and would have been settled and ended with proper diligence on the part of the applicant long before it was settled, and the delay of two years and more which took place before the question was determined would have been avoided.

After the substituted specification had been pending in the patent office a year and a half, and the question arose as to the admissibility of the matter, embracing the feature of constant contact between the electrodes as an amendment of the application, the fact that it had remained so long without rejection was vehemently urged by Pollok as constituting an estoppel and a reason why it should not be rejected; and as time went on, year after year, this argument was used with more and more force, and it became at last one of the prevailing reasons why the officials of the Patent Office consented to allow the broad claims and to issue patent 463,569.

It should be stated that when the question involving the right of Berliner to introduce the changes in his application, which have already been pointed out, was brought before the patent office, it was decided by the examiner in charge of the application that the broad claims and the new matter in the substituted specification on which they were founded would be admissible only upon proof that the invention covered thereby was made by Berliner prior to the filing of his original application and formed part of the subject matter of the application, in which decision the respondent company acquiesced, and by its solicitor, Pollok, caused Emile Berliner to make affidavit, dated May 25, 1882, and filed May 27, 1887, in which it was stated:

That the matter described and claimed in the several amendments heretofore made to the said application of June 4, 1877, and incorporated in the substitute specification filed September 1, 1880, as well the matter which has been canceled and transferred to the said divisional application as that which remains, was invented by him prior to June 4, 1877, and formed part of his original invention subject of the application filed of that date, and that to the best of his knowledge and belief no part of the said invention, as set out in the aforesaid substitute specification, was in public use or on sale in the United States for more than two years prior to the application therefor.

After the filing of this affidavit it was held by the examiner that the broad claims and the matter in the substituted specification supporting them were admissible and allowable.

The statements in this affidavit are pronounced false by the attorney-general, who contends that Berliner did not invent the apparatus described in the amended application prior to June 4, 1877, and that the incorporation of this amendment was procured by fraud on the part of the telephone company and Berliner. In this connection it is argued by the complainant:

If the new matter embraced in the substituted specification and introducing into the application the new and broad invention of constant contact between the electrodes in a telephone transmitter could be lawfully introduced into the application, as it was, upon the applicant's oath that this matter constituted a part of his original invention made before the filing of his original application, it must be upon one of two assumptions of law, viz., either (1) that such amendment could be deemed and taken to relate back to the filing of the original application and to constitute part of it in legal effect, or (2) that the application should be deemed and taken to have been filed, so far as concerns the new matter introduced by said amendment of September 1, 1880, and covered by said affidavit of May 27, 1882, at the time of the filing of said affidavit.

If the former assumption is true in law, then it follows that the application upon which said patent 463 569 was issued was not completed and prepared for examination by the commissioner of patents within two years from the filing thereof, as the law requires, and the patent is for that reason void. If the latter of the assumptions is true in law, then the patent 463,569, as to all that part of the specification and claims which was included in the amendment of September 1, 1880, and was not included in the original application, and was covered by the affidavit of May 27,

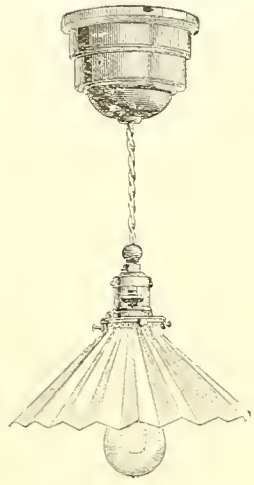
1882, must stand and be taken as though the application therefor had been filed May 27, 1882.

It is shown that instruments embodying Berliner's claims in the amended application were in use throughout the United States by the telephone company for more than two years prior to the presentation of the amended application. Berliner himself secured several patents about that time in which the same features were thoroughly covered. Some of these were upon transmitting devices, others on receivers, and another on the general principle and application. Concerning the instrument described in the drawings it is contended that it is not practical, but is admittedly useless as a commercial device and cannot be said to embody any improvement or novelty in the art of telephony.

The case was adjourned until March 6th, at which time the telephone company is expected to file its answer.

Harter Anti-trust Bill.

Representative Harter, of Ohio, is the author of "An Act to Suppress Trusts, and for Other Purposes," which suspends, so long as the trust combination continues, all tariff duties and patent rights by which the dealers in



ADJUSTABLE ELECTROLIER.

the articles derive any advantage over foreign and domestic competitors.

It differs from the bills of a similar character introduced by Mr. Breckinridge, of Arkansas, in the last Congress, in covering every article which is the subject of a trust combination, instead of specifying certain articles, and it suspends tariff duties and patent rights only so long as the trust continues instead of suspending duties absolutely. The bill was referred to the committee on manufactures, of which Mr. Harter is a member, and it is expected it will be reported. Mr. Harter's bill is substantially as follows:

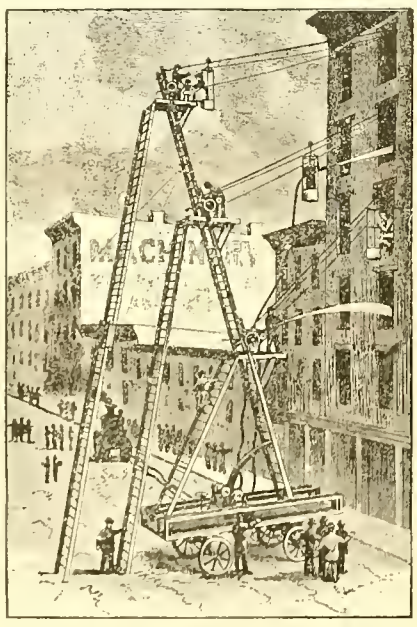
SEC. 1. Whenever the secretary of the treasury of the United States is supplied with satisfactory proof that the manufacture, distribution, price or terms of sale of any article of general consumption is practically under the control or direction of any association, combination, trust or syndicate, it shall be his duty to declare the fact publicly in a manner selected by him, and if within thirty days after such public notice or declaration he shall not be satisfied that such association, combination, trust or syndicate has been dissolved, and that the manufacture, distribution, price and terms of sale of such articles are again under control of ordinary influences, he shall place said article upon the free list; provided, that if the article is subject to an internal revenue tax, then a tariff tax equal to such internal revenue tax shall remain and continue upon said article.

SEC. 2. When any article is placed upon the free list as provided by section 1 of this act, due public notice of the fact shall be given by the secretary of the treasury, and all patents relating to said article, which at that date or which thirty days or more before belonged exclusively to any person, firm or corporation, who or which was then and is a party to any such association, combination, trust or syndicate, shall thereupon become void from the date of said public notice, and all courts of the United States shall treat such patents as having expired.

In regard to this measure Mr. Harter said: "I wish to say that I intend amending my bill, and will add as an additional penalty the law of copyright, trademark, and other property of that nature, which legitimate firms, persons and corporations enjoy and value because of the profit arising from them. It is only a question of a moderate length of time, when the reign of the trust will be over, and certainly the projectors and owners of these affairs cannot complain. If the people have their inning under this bill, it will be because the trust so elects, for the thirty days' clause is a saving ordinance in the premises. A business man myself, a free-trader, or taxer for revenue only, I am desirous of seeing any legitimate business go on without interference, but when action against trusts is needed, as it is needed now, I believe in a thorough-paced law, not a 'how not to do it' act, such as we now have. Let all who read my bill apply the proposed law to any trust in sight, and see how it would dissolve it, or if not, how it would draw its fangs or clip its claws."

Pauly's Improved Fire Apparatus.

Among the objections to overhead wires in large cities, the most serious has been the protest of fire departments, which have maintained that their work was seriously interfered with by the presence of the network of telegraph, telephone and electric light and power lines in front of burning buildings. To overcome this trouble, M. A. Pauly of Eau Claire, Wis., has devised an ingenious combination of a fire escape and extinguisher which is illustrated in the accompanying cut. The arrangement consists of the front wheels of common wagons, on which rests a frame four feet wide, three feet high and thirty feet long to carry detachable ladders, an exension ladder and the gear mechanism for actuating the rack bars that raise the extension ladder to its vertical position. The hind wheels may be held at any angle by two levers. The main section of the ladder is journaled at the bottom to a shaft in the front end of the frame, and is raised by a system of gears and two rack bars, one at each rail. Near the top of this section is an adjustable platform that is 2½x5 feet, held horizontally by two standards that snap around one of the rungs. Four feet above the platform is a 15-inch cylinder, two and one-third feet long, around which the endless cable that runs the life-car back and forth winds and unwinds, and which is so arranged as to have compartments for insulated shears to cut wires, the life lines and car. Back of this cylinder is a triangular nut that runs on a screw shaft which is turned by a gear that meshes the same large gear that the one attached to the cylinder does, the nut being held in position by sliding at one corner along a stationary shaft, and is for the purpose of holding two arms that guide the life-car cable truly around the cylinder. From the outside of the side rails near the top two sets of triangular arms, one set holding small gears that mesh rack bars along one-half the width of the back edges of the side rails of the second section, the other set being journaled to hold a crank shaft on which two gears are keyed that mesh the same rack bar. These gears are to run the second section up in position, and they and the first mentioned gears are to overcome the tendency of the second section to sag back until the second back ladder is adjusted to its platform. The platform, cylinder and gears are arranged exactly the same at the top of the second as those of the first



PAULY'S IMPROVED FIRE APPARATUS.

section, and those of the third or last are the same, though without the attachments for raising another section. Each back ladder is fitted with snaps at both ends, those at one end to engage suitable shafts in the top of the frame, while those at the other are snapped into rings at the back ends of the beams of the platforms. The ladder is braced sidewise by two props that are fastened to the side rails of the main section by ball and socket joints.

When in use the apparatus is wheeled to the desired position, the gears of the frame are turned, actuating the rack bars which force the extension ladder to the desired angle; meanwhile a man climbs to the top of the first section, turns the gears that run section two to its position, swings the platform out, adjusting the front standards and snapping the back ladder to the platform. A small rope tied to a hook and pulley at the loose end of the life lines is then thrown to a window in the building, where the hook is placed in a ring in the window casing or ceiling, after which the life lines are adjusted to the proper tension, and the fireman begins to operate the gears above the platform to move the car back and forth. Another fireman, in the meantime, runs up the third section, and in a similar manner adjusts its platform and back ladder, and makes the life line connection. To overcome any liability to sag back of the section being raised, a triangular arm ending with a gear wheel runs in a rack bar in the outside of each side frame of a section, being firmly fastened to the outside of the side frames near the top of the stationary section. The platforms are designed to be sufficiently strong to prevent the sectional ladders from being pulled forward or sagging backward.

The Jupiter Dry Battery.

The Columbia Manufacturing & Supply company, Chicago, is introducing a dry battery for which some stroog claims are made. The "Jupiter," as the cell is called, has

JUPITER DRY BATTERY.

been before the public, the company states, for the last three years and has given satisfaction. A number of the Jupiter batteries that were put in service three years ago are still doing good work. The cell is adapted for service in connection with electric bells, burglar alarms, annunciators or any other devices that can be operated by an open-circuit battery. Its makers claim further that this battery will not freeze; there is no fluid to evaporate nor salts to form; no glass jar to break and no poisonous chemicals. The electromotive force of the cell is 1½ volts.

Adjustable Electrolier.

The accompanying illustration represents a novelty in the line of an adjuster for raising or lowering incandescent lamps suspended on cords. It differs essentially from other devices for this purpose, in the fact that the regulating device is attached permanently to the ceiling, taking the place of a ceiling rosette or cutout. The cord is therefore not made clumsy by a heavy adjusting ball, and the movement up and down is more readily controlled and more certain. In appearance the adjustable electrolier is very neat, resembling a polished brass canopy. The Electric Appliance company, Chicago, is looking after the interests of this new device in the West.

Beacon Company Enjoined.

The Edison Electric Light company last week obtained a preliminary injunction against the Beacon Vacuum Pump & Electrical company, Boston, restraining it from manufacturing incandescent electric lamps which infringe the Edison patent. This restraining order was made by Judge Colt, of the United States Circuit Court, before whom a hearing was recently held. Judge Colt in his decision says: "It has been often laid down that a meritorious invention is not to be defeated by something which rests on speculation or experiments, or which is rudimentary or incomplete. The law requires not conjecture, but certainty. It is easy, after an important invention has gone into public use, for persons to come forward with claims that they invented the same thing years before, and to endeavor to establish this by the recollection of witnesses as to events long passed. Such evidence is to be received with great caution, and the presumption of novelty arising from the grant of the patent is not to be overcome except upon the most clear and convincing proof. When the defendant company entered upon the manufacture of incandescent lamps in May, 1891, it well knew the consequences which must follow a

favorable decision for the Edison company in the New York case. Owing to the large interests involved, I have carefully considered this motion, and I am satisfied upon the evidence and the law applicable thereto that it should be granted."

CORRESPONDENCE.

New York Notes.

NEW YORK, February 18.—There are several bills pending in the legislature which affect the electrical interests of this city and state and the people generally. One of these, an act to create a telephone commission, has attracted little public attention.

This bill provides for the appointment by the governor of three persons to constitute a State Board of Telephone Commissioners. One of the members must be a Democrat, one a Republican, and the third must be selected without reference to his party affiliations. These gentlemen are to meet at least once a month at Albany. The board is to have a clerk or secretary who shall serve, at a salary not exceeding $3,000 and may employ other clerical assistants, accountants, and experts at a total cost not to exceed $25,000 a year, which is appropriated by the bill and declared to be a continuous annual appropriation to carry out the provisions of the act. The members of the commission are to receive $10 per day for the time they devote to the public. The principal duties of the telephone commissioners will be to investigate complaints made against telephone companies doing business within the limits of this state, and to fix and declare such charges and prices as they shall deem just and reasonable for telephonic communication by any telephone company against which complaint is made. They will also be empowered to require the corporations affected by the act "to provide for the use of their customers or subscribers the most approved appliances, instruments, and connections owned, controlled, or leased by them for the transmission of telephonic vocal messages at the charge and price fixed by the commission."

The other bills of greatest interest are those relating to the Rapid Transit commission. There are now two bills before the legislature, the Farquhar bill and Ellison bill. These measure are opposed to each other. The Farquhar bill proposes to put an end to the present commission and have a new one appointed, and to allow the utmost liberty to private capitalists in dealing with the franchise. It puts no restriction upon the amount of stock and bonds which the company to be formed may issue, lays down no requirements regarding the fares to be charged, provides virtually for such modification of plans as the company may desire, and relieves it from the supervision of the commission in the work of construction. In short, it allows the utmost latitude to private "enterprise." The Ellison bill, on the other hand, proposes to continue the present commission and to have it submit to a vote of the people the question of having rapid transit roads built for the city at public expense. In case of an affirmative vote the commission would be required to contract with some "person, firm, or corporation" for the construction of the roads the same "person, firm or corporation," to equip, maintain, and operate them and pay a certain annual rental to the city, determined by the amount of municipal bonds issued for the cost of construction.

The engineers of the Rapid Transit Commission are preparing plans for extensions of the Manhattan company's system. The preparation of the plans now intrusted to the engineers is admitted to mean that the commissioners feel that the best thing they can do at present is to bring to some kind of climax the negotiations that have been opened with the Manhattan company. W. F. O.

Northwestern Notations.

MINNEAPOLIS, February 18.—The council at Litchfield, Minn., has given the Western Union company the right to put up poles and wires.

The Electrical Engineering & Supply company of St. Paul has increased its capital stock to $150,000.

Lanesboro, Minn., has voted $10,000 bonds for electric light and water works.

Parkston, S. D., proposes to have electric lights.

The National Electric & Mechanics' Insurance association has been organized in Minneapolis.

The Renville, Minn., Consolidated Telephone company has been incorporated with $15,000 capital. Jesse T. Brooks, M. J. Dowling, Chas. Bricke, Timothy O'Connor, R. T. Daly and George S. Humphrey are the incorporators.

The St. Paul board of aldermen has passed the ordinance giving the East Side Electric Light company the right to put up poles and wires in the Arlington Hills and Dayton Bluff districts.

Articles of incorporation of the Devil's Lake, N. D., Electric Light & Street & Suburban Railway company have been filed.

Lake Benton, Minn., wants electric light and water works and has asked the Legislature to give the desired permission to issue bonds.

Manager Sherman of the Stillwater telephone exchange is figuring on establishing an exchange at Hudson.

The Butte, Mont., General Electric company has filed amended articles making its capital stock $850,000 and the limit of indebtedness $1,000,000.

A company, headed by ex-Mayor Ball of that city, has asked the council of Fargo, N. D., for a franchise for a new electric light and power plant and privileges. The company proposes to make its rates just half those of the present company.

Engineer Smith, formerly employed by the Minneapolis Street Railway company, is now in charge of the work of introducing the electric system on the street railway lines at La Crosse, Wis. The work is to be pushed this season to the utmost limit.

The consolidation of the power, light, waterworks and street railway interests at St. Cloud, Minn., is progressing. There is some delay due to the desire to secure certain legislation. C. S. Benson will be general manager, and J. A. Chase, formerly of Minneapolis, secretary. The capital stock will probably be $500,000, which will be in the hands of local capitalists and the General Electric company.

M. de la Fere, of Minneapolis, has a device which he proposes to exhibit at the World's Fair. It is for a rapid transit system using a single rail and electricity for motive power. He claims that he can get double the speed that the ordinary double track arrangement permits. He will also exhibit the model of a submarine boat run by electricity.

Charles Steiner, the civil engineer of Minneapolis who has a scheme to utilize Minnehaha falls, generate electricity, and cause a general commotion in the community, now talks of organizing a company to put his theory into practice. He has presented his plan of operation to the engineers' clubs of Minneapolis and St. Paul, but they declined to go on record as indorsing it.

At a meeting of a special committee from the St. Paul city government last night it was finally decided to accept President Lowry's latest proposition looking toward an adjustment of the wrangle over street railway matters. It is to be hoped that this will settle it, though approval by the aldermen is necessary.

The Western Union Telegraph company has on its hands a $10,000 damage suit of a peculiar description. The plaintiff is Samuel D. Peterson, a member of the state senate, now in session in St. Paul. Senator Peterson thinks he has been damaged to the extent named by a message which the company transmitted, reading as follows: "Slippery Sam, your name is pants." This little expression of endearment was the outcome of the senatorial struggle in the Legislature. Peterson, a republican member, was expected to vote for Davis in accordance with the wishes of his district as expressed in party conventions. He did not so vote, and some indignant politicians sprung this message on the unsuspecting wires. The dispatch was signed "Many Republicans." The telegraph company refused to give him the name of the sender. The senator is especially sensitive in view of the newspaper talk about the use of money in connection with the senatorial fight.

The legislatures of the northwestern states have not yet put any bills through affecting electrical interests, although plenty of them have been introduced and discussed. The measure proposing to create the new office of examiner of telegraphers and provide for licensing operators has been defeated by the Minnesota solons. It may be revived, however. The bill extending the right of eminent domain to electric light and other companies has caused much debate. This is the bill framed for the special benefit, it seems, of the proposed consolidation at St. Cloud. With some amendments it was recommended by the committee to pass. The Davis bill limiting the charge for the rent of telephones to $3 for the first, and $2.50 for more instruments has been further discussed in committee. At its last hearing the committee also considered the bill for taxing the gross earnings of telephone companies. D. F. Morgan, of Minneapolis, entered protest in behalf of the company against all such legislation. He said the proposed tax of 5 per cent. was so evidently onerous and unjust as to call for no argument. The company now pays the taxes on the full value of its plant. Senator Donnelly put through the Minnesota Legislature, without any debate, a resolution in favor of a governmental system of telegraph. Resolutions to the same effect have passed the lower branch of the North Dakota Legislature. The North Dakota Senate, by the way, has passed a bill for the prevention of the cutting of telegraph and telephone wires, "tapping" or interfering with them in any way. This is a reminder intended as such of the great lottery fight of two years ago, when wires were tapped and messages delayed. H. C. C.

Milwaukee, Wis.

MILWAUKEE, February 18.—During the middle of the week the Northwestern Electric Light association held a meeting in this city. The meeting began Wednesday morning and did not adjourn until Thursday afternoon. The association embraces the states of Wisconsin and Minnesota and Northern Michigan. The principal matter discussed was a proposition to ask the Legislature to pass a bill providing for the appointment of electrical commissions in cities lighted by electricity. The proposition was received with favor, but there seemed to be considerable doubt as to whether the Legislature would enact any such law. Among those present at the meeting were W. D. Baker, Waupaca; Carroll Collins, Green Bay; E. L. Debell, Sheboygan; George A. Davis, Neenah; C. C. Page, Oshkosh; C. S. Leykum, Antigo; J. S. Stevens, St. Paul; H. Schulcamp and C. Gunderson, Madison; J. E. Bower, Crystal Falls; J. F. Wiley, Hancock; M. Nippert, Lake Geneva; I. P. Lord, Waupaca; John Schuette, Manitowoc; John F. Fitzpatrick, Crystal Falls; T. A. Pamperin, Oconto. Mr. Collins is president, Mr. Page vice-president, and Mr. Pamperin secretary and treasurer.

On the lines of the Milwaukee Street Railway company blockades continue to be more frequent than the public relishes. Considerable feeling is shown by patrons of the lines, and once more there is talk of asking the Common Council to take steps to compel the company to give better service. An incident that occurred a few days ago illustrates the state of the public mind. The street railway people decided not to run a car containing thirty passengers through to the end of the Third street line, but to transfer the passengers to another car and to run the first car back to the other end of the line. The passengers, who had already been delayed by the stoppage of the cars, loudly protested against being transferred, and they proceeded to hold an indignation meeting. They discussed the situation and came to the decision to remain in the car no matter where it went. In accordance with this determination, they refused to budge and were carried clear to the wrong end of the line and back again. A list of the passengers was made up, and they all expressed a willingness to contribute to a fund for the purpose of bringing a test suit for damages. They adopted resolutions to that effect. Superintendent Lynn, in explaining the trouble, states that it is not due to a lack of power, as the temporary power house has at last been started up, but to other circumstances which are unavoidable. The fire at the Kinnickinnic avenue barns, he said, not only destroyed a large number of cars, but destroyed the snow plows and the street sweepers. Immediately after the fire new plows were ordered, but they did not arrive until just after the first big storm. Some parts of the plows have not yet been received and the plows are not mounted. Superintendent Lynn says that before another big storm everything will be in order. He adds that some of the recent delays have been due to broken wires and to loaded wagons breaking down on the track.

At the annual meeting of the Milwaukee & Wauwatosa Rapid Transit company the following named officers were re-elected: President, Charles Stickney; vice-president, Julius Wechselberg; secretary and treasurer, C. W. Henning; general superintendent, E. D. Hoyt. Messrs. Wechselberg, Henning and Eugene S. Elliott were elected directors for three years. The reports showed that the road was in a very satisfactory condition. The double-tracking and the extension to the West Side park will be completed within three weeks after the weather allows work to be begun.

Alexander Maitland, of Negaunee, Mich., has resigned as president of the Negaunee & Ishpeming Railway & Electric company. Charles Merryweather has been chosen to succeed him. Harvey Pearce has succeeded W. E. Berry as superintendent.

The annual meeting of the Wisconsin Telephone company was held in this city a few days ago. Charles Ray, H. C. Payne, F. G. Bigelow, C. G. Hack, Fred Vogel, Jr., and B. K. Miller were elected directors. The officers are as follows: President, Henry C. Payne; vice-president and treasurer, F. G. Bigelow; secretary and general manager, John D. McLeod; general superintendent, E. B. Cottrill; auditor, D. E. Roberts; purchasing and contracting agent, S. O. Giddings.

Henry C. Payne, who has returned from an eastern trip, says that new cars for the Villard lines are being built as

rapidly as possible and that some have already been shipped. They are all to be ready by March.

Judge Johnson, of the Circuit Court, has rendered a decision in the matter of the application of Gustavus J. Melms, the receiver of the Milwaukee Electric Railway company, for permission to sell the road and everything pertaining to it. The court ordered a sale July 1st, in accordance with the petition of the receiver. The decision of the court is a victory for Charles F. Pfister, who is the principal creditor, and at whose instance the receiver was appointed. Francis E. Hinckley, of Chicago, the chief stockholder of the company, opposed the sale, but simply succeeded in bringing about a delay of some weeks. In making his decision, Judge Johnson said that he considered it for the best interests of all concerned that the road should be sold. He said that he would pass upon the ratio of amounts that should be paid to the creditors. The receiver is to operate the road until the day of sale and to keep it in repair. He is to pay the employes of the road in receiver's certificates. Mr. Pfister's claims against the company approximate $200,000. In addition to the judgment upon his claim of $125,000 and interest, representing money loaned upon collateral security, he holds several mortgages against the company. It is not doubted that the Villard syndicate will purchase the road at receiver's sale. The company's trouble, it might be well to explain, was caused by internal dissension.

A course of lectures has been arranged at Madison for the benefit of the engineering department of the Wisconsin University. Among the lecturers are William Carroll, superintendent of construction of the electrical department of Chicago; H. D. Mitts, of Detroit, signal engineer of the Michigan Central Railway company; Richard Burkholz, mechanical engineer of the Pabst brewery, Milwaukee; Prof. A. J. Rogers, principal of the Milwaukee high school and president of the Wisconsin Electric club; Thomas Pray, Jr., and Thomas West, of Chicago, and Don J. Whittemore, chief engineer of the Chicago, Milwaukee & St. Paul Railway company.

The Common Council of Wausau has granted a franchise for an electric railway. The projectors of the enterprise are Walter Alexander, Hiram Dunfield, B. E. Jones and J. D. Ross. By the terms of the ordinance work is to be commenced in June and about three miles of track is to be completed within eighteen months. The line will reach out to the city limits at various points.

A Municipal Reform League is being organized in Milwaukee and an attempt is being made to have it adopt the cause of city electric lighting. Robert Schilling, the leader of the municipal lighting agitation, was a member of the committee appointed to draw up a declaration of principles for the Municipal Reform League. He did not succeed in getting the committee to endorse his pet views, and he took the matter into the meeting of the league. He said that Milwaukee had 675 arc lights, for which the sum of $112.50 per lamp per year is paid. He referred to Bloomington, where the municipal system prevails, and said that the price which each lamp costs that city is only $62.50 a year. He said that Staunton, W. Va., has 1,200 candle power lamps, burning ten hours a day, and only pays $24 a year apiece for them. He also asserted that a Chicago company recently offered to establish an electric light plant at Minneapolis, charge only a slight advance over the present rates, and at the end of five years turn the property over to the city for $1. Mr. Schilling, before he got through, went a great deal further than the advocating of a municipal lighting system. He wanted the city to secure control of the street car lines and to reduce the fare to one cent. The municipality could take the step without losing money, he said, and the benefits, especially to the poor people, would be incalculable. Such a system would permit people of very little means to live in the outskirts of the city instead of being penned up in tenements, and it would improve health and increase the wealth of the city. No action was taken on Mr. Schilling's propositions.

Henry C. Payne states that the Villard syndicate will take hold of the West Side railway on April 1st. In the meantime all necessary preparations will be made so that the two systems can be merged into one without friction of any kind.

The Cleveland Iron Mining company and the Pittsburg & Lake Angeline Mining company have ordered dynamos, engines and motors for their mines, which are among the largest and best paying on the Marquette range, and soon they will each have a complete electric tramway system. The cost of each plant will be about $25,000. The improvement will probably effect a great saving, as it is claimed that by using the electric tramway system ore can be hauled to the shafts at a cost of only from two to four cents a ton. The two mining companies named hope to retain an advantage over the mines in the newer districts by reason of the improvement. It will be the first introduction of electrical power for tramways in that region. The mines of the Lake Superior district have always had the reputation of keeping abreast of the times, and they seem determined to retain it.

Madison's common council has opened bids for lighting that city with electricity during the next two years. Schulkamp & Houseman were the lowest bidders. The other bidders were the Four Lakes Light & Power company and a Chicago concern. A few months ago Schulkamp & Houseman sold their electric plant to the Thomson-Houston company for $51,000, and that company secured the contract for furnishing power to the electric railway. Schulkamp & Houseman's successful competition with the Four Lakes Light & Power company, which succeeded the Thomson-Houston concern, was in the nature of a surprise. C.

New England Notes.

BOSTON, MASS., February 18.—H. H. Wardwell, who has just resigned the foremanship of the switch and repair department of the Consolidated Electric Manufacturing company, in order to accept a situation in Pittsburg, was presented by the managers and employes of the company a handsome Knight Templar charm.

Lancaster, N. H., is moving in the matter of electric lighting. The Coos & Grafton Electric Light & Power company has just been organized with a capital of $125,000, and has purchased a water power in the town of Dalton, with the idea of furnishing light and power to towns within a radius of 25 miles.

It cost the city of Boston $582,113.83 for light the last year. Of this amount $225,862 went for electric lights. The report of the superintendent of lamps recommends that the large gas lamps which burn from 15 to 30 feet an hour be removed and electric lights be substituted, as they are cheaper.

The Lowell Electric Light company is putting in a new Thompson-Houston dynamo with capacity for 2,000 incandescent lights.

The recent absorption of the Union Street Railway company, of Providence, R. I., by the Narragansett Electric Light company, is now said to be but the first step in a consolidation of the street railways, of the state. United States Senator Aldrich and S. Pomeroy Colt, president of the Industrial Trust company, are interested. The next move is to be upon the lines in the Pawtucket and Blackstone valleys.

As a means of getting better communication with Boston, Stoneham people have petitioned the legislature for a charter for the Malden, Melrose & Stoneham Street Railway company, with a capital of $180,000. There seems to be no opposition to the scheme. None has developed from Stoneham at any rate, and at the first legislative hearing many influential men appeared in favor of granting the charter.

The city of Haverhill has voted to establish an electric lighting plant, but it asks the legislature for a special act to enable it to furnish light for municipal purposes without purchasing the plant of the Haverhill Electric Light company, which it would have to do under the municipal lighting act of last year. The city officials say they are willing to purchase at a fair valuation, but the company places an exorbitant price on its works.

Longfellow's "Wayside Inn," which has been in the possession of one family for something like two centuries, is about to be stirred from its peaceful repose by the approach of the electric car. It has just been sold to ex-Mayor Howe of Marlboro, and ex-Alderman Homer Rogers of Boston. The former gentleman is interested in the state central belt of electric roads which include Marlboro, and it is thought that an electric road will soon be built to connect Marlboro with Sudbury, in which town the old inn is. It would then be within easy reach of sight-seers, and it is intended to build a hotel close by and preserve the old place as an attraction for visitors.

The Knox Gas & Electric company has been incorporated at Rockland, Me., for the purpose of furnishing light, heat and power to the towns of Thomaston, Warren, Camden and Rockport. It has a capital of $200,000. It is a consolidation of the Rockland-Thomaston Gas Light company, the Camden & Rockport Electric Light company and the Thomaston & Warren Electric Light & Power company.

The Dedham, Mass., selectmen have refused to grant the Norfolk & Suburban Street Railway company permission to lay tracks in the town. This is understood to mean that no electric road will be allowed in the town this year. The present board of selectmen will go out of office in March, and it is proposed to make the question of an electric road one of the issues of the town election.

Mr. Dumouslin, electrician, has resigned from the service of the West End Street Railway company to engage in private business. Mr. Pearson will still be the consulting engineer of the road while devoting the most of his time to the interests of the Whitney coal combine in Nova Scotia.

Stories that the West End was to be bought by the Philadelphia syndicate which controls the street railways of the North Shore have been numerous lately. President Whitney denies them all.

J. C. E.

Washington, D. C.

WASHINGTON, February 18.—The district commissioners have given a hearing to the advocates and opponents of the proposed new electric railway and bridge between Virginia and this city. The principal objection was the bridge feature. It was asserted that it would injure business interests in Georgetown, and destroy the commerce of that part of the city. The opponents threatened to carry the fight into the courts to prevent the construction of a bridge between the aqueduct bridge and the Long bridge. A bill has been introduced in the House by Mr. Meredith of Virginia in behalf of the road, which is called the Washington, Alexandria & Mount Vernon Railway company, which proposes to extend its existing line between Mount Vernon and Alexandria to this city, and build at its own expense an iron bridge over the Potomac, from the front of the Arlington reservation to the Potomac flats, opposite the foot of Seventeenth street. This bridge is to have on each side of the double track electric railway a carriage way and footway, which will be free to the public. From the bridge the railway is to cross the Potomac flats north of the tidal reservoirs to the junction of Seventeenth and B streets, thence along B street to Fifteenth street, and thence along First street to the south side of Pennsylvania avenue, opposite the Hotel Randall. This means an electric railway from the treasury department, executive mansion, Washington monument and hotel center of the city to the tomb of Washington at Mount Vernon. It is to be an express line, with no stop except at Alexandria.

George Truesdell, president of the Eckington & Soldiers Home Electric Railway company, has submitted to Speaker Crisp his annual statement of the names of stockholders of the company, the amount of stock held by each, and the receipts and disbursements for the year ending December 31, 1892. The total receipts were $100,249.05, and the total disbursements $95,423.80. The total number of passengers carried was 2,251,485.

At a meeting of the stockholders of the Chevy Chase' Land company of Montgomery county, Maryland, it was decided to sell to the Rock Creek Railway company of the District of Columbia, for the sum of $200,000 in cash, the company's railway, including the right of way, tracks, poles, wires and electrical apparatus, together with land necessary in connection with the Rock Creek railway for station houses and other purposes. This road connects with the Rock Creek railway at its terminus.

No objector to the proposed incorporation of the Washington, Burnt Mills & Sandy Springs Railway company appeared before the district commissioners, who held a board session for the purpose recently. Guion Miller, on behalf of the incorporators, explained that the railway within the district is intended as an annex to the Burnt Mills & Sandy Springs Railway company of Montgomery county, Maryland, which will run from a point near the Sargent road, through a portion of Prince George's county, to Burnt Mills, and thence along the Colesville turnpike to the village of Ashton, near Sandy Springs, Montgomery county. G. M. P.

PERSONAL.

F. W. Cushing has just returned to Chicago from his London Trip.

George B. Prescott, Jr., who until quite recently was prominently identified with electrical interests in the East, died February 13th at Northampton aged 35 years. During the last year Mr. Prescott visited Bermuda with a view of recovering his health, but on his return to New York he failed rapidly. His death, however, will be a shock to his friends in the electrical fraternity, who esteemed him highly.

William McDevitt, chief of the electrical department of the Philadelphia Fire Underwriters' association, sailed for Europe on the North German Lloyd steamship Lahne on February 21st. Many claims have been made by authorities in foreign countries of superior methods in the distribution and use of the electric light, especially in wiring for houses and for safety from fire. This subject Mr. McDevitt will particularly inquire into, and he will also examine the safeguards used for the protection of theaters. Mr. McDevitt will visit Berlin, London, Paris, Vienna and Marseilles at the request of the electrical contractors, central stations and electrical engineers of Philadel-

phia who are interested in this work, and who believe that American methods are not behind those that obtain in Europe. The Philadelphia Fire Underwriters' association has granted Mr. McDevitt a two months' leave of absence, and he carries with him letters from Hon. Edwin S. Stuart, mayor of Philadelphia, to the municipal authorities abroad. A full and interesting report is looked for and one which cannot fail to be of great use to the electrical fraternity in general.

NEW INCORPORATIONS.

Radford Electric Light & Power company, Radford, Va.; capital stock, $35,000; operating an electric plant.

Power City Illuminating company, Niagara Falls, N. Y.; capital stock, $5,000; to manufacture and use electricity for light, heat and power.

Norwalk Electric company, Norwalk, O.; capital stock, $50,000; manufacturing and furnishing light, heat and power; Charles Suhr, Norwalk, O.

Saginaw Power company, Saginaw, Mich.; capital stock, $50,000; to manufacture, sell or rent electricity for heat and light; Frank F. Snow, Detroit, Mich.

Wilkesbarre & Plymouth Railway company, Wilkesbarre, Pa.; capital stock, $30,000; electric railway in Luzerne county, Pa.; Alex. Farnham, Wilkesbarre, Pa.

Pottstown, Boyertown & Reading Railway company, Pottstown, Pa.; operating electric railway from borough of Pottstown to Boyertown; M. G. Taylor, Pottstown, Pa.

Wilkesbarre & North Side Railway company, Wilkesbarre, Pa.; capital stock, $30,000; electric railway from Wilkesbarre to suburbs; Alex. Farnham, Wilkesbarre, Pa.

Citizens' Railway company of Chester county, West Chester, Pa.; capital stock, $80,000; electric railway in West Chester, Pa.; T. L. Eyre, Insurance Department, Harrisburg, Pa.

Harrisburg & West Side Electric Railway company, Harrisburg, Pa.; capital stock, $100,000; operating electric railway in Perry and Cumberland counties, Pa.; Chas. B. McConkey, Harrisburg, Pa.

Electrical & Mechanical Engineering & Trading company, New York, N. Y.; capital stock, $150,000; to act as consulting and contracting engineers for electrical or mechanical construction or both.

Humboldt Electric Light & Power company, Eureka, Cal.; capital stock, $50,000; to manufacture and sell electricity, deal in machinery, and do a general electric business; J. M. Melendez, Eureka, Cal.

Baltimore Avenue Railway company, Philadelphia, Pa.; capital stock, $50,000; electric railway from a point in Delaware county to Philadelphia, Pa.; Wm. Jenks Fell, 131 South Fifth street, Philadelphia, Pa.

Municipal Electric company, Decatur, Ill.; capital stock, $25,000; to operate electric, heat and power plant, manufacture and sell electrical appliances, gas machines, etc.; Municipal Electric company, Decatur, Ill.

Electrical Railway Equipment company, Jersey City, N. J.; capital stock, $120,000; to make, buy, sell, use and deal in electrical appliances and devices, etc.; Paul K. Ames, 15 Wall street, New York, N. Y.

People's Electric Light, Power & Heating company, Springfield, Ill.; capital stock, $50,000; furnishing electric light, heat and power; People's Electric Light, Heat & Power company, 317 South Fifth street, Springfield, Ill.

Selinsgrove & Sunbury Electric Railway company, Sunbury, Pa.; capital stock, $100,000; operating electric railway beginning near Clement Station, Snyder county, to Selinsgrove borough; Charles M. Clement, Sunbury, Pa.

Cincinnati & Dayton Electric Railroad company, Cincinnati, O.; capital stock, $100,000; constructing and operating railroads between Cincinnati and Dayton, to be operated by electric or other motive power; J. B. Foraker, Cincinnati, O.

Standard Fire Protection company, Chicago, Ill.; capital stock, $150,000; to manufacture and sell automatic electric fire and burglar alarms, fire extinguishing appliances, electric novelties, etc.; H. Allerton Hutson 71 Dearborn street, Chicago, Ill.

United Traction & Electric company, Jersey City, N. J.; capital stock, $8,000,000; to build, construct, equip, enlarge, complete or connect railroads, whether operated by horse, steam, cable or electric power, etc.; Butler, Stillman & Hubbard, New York, N. Y.

Electrical Installations company, Chicago, Ill.; capital stock, $25,000; to construct and operate dummy and electric street railway and plants, manufacture and furnish light, heat and power and deal in all kinds of electrical machinery, appliances, etc; David J. Wile, 1516 Unity Building, Chicago, Ill.

ELECTRIC LIGHTING.

A special committee has recommended to the council of Knoxville, Ill., that the city put in an electric light plant.

The Eastern Electric Light company has secured the contract for lighting the town of Wyandotte, Mich., at $11,500 per year.

J. P. Smith, of Fullerton, Neb., has secured a ten-year franchise for the establishment of an electric light plant, in connection with which he intends to operate a system of water works. He invites correspondence from manufacturers.

Mayor Armstrong is authority for the statement that Pierce City, Mo., is figuring on increasing the capacity of its electric plant to 1000 incandescent lights.

The Rockford Electric Manufacturing company has been awarded the contract for putting in the electric light plant at Schott's saddlery works, Quincy, Ill. There will be 150 lights, and the contract price is about $800. The work will be completed in thirty days.

A dispatch from Montreal announces the circulation of a report that a Montreal syndicate has a scheme on foot to buy up all the electric lighting and gas companies in Canada, with a view to forming a great monopoly. There is an electric lighting bill now before the Dominion parliament, and the syndicate is said to favor its passage, as the powers under which the gas and electric companies are at present working make no provision for such an amalgamation as is contemplated.

In the Circuit Court of St. Louis Dwight Tredway is plaintiff in a suit brought against the Missouri Electric Light & Power company and Samuel M. Dodd for the recovery of a half interest in the stock of the company of a par value of from $100,000 to $250,000. The plaintiff alleges that in 1888 he entered into a contract with the Westinghouse Electric company, of Pittsburg, that he should enjoy the exclusive right to the use of that company's electric lighting by steam in the city of St. Louis. He took the defendant Dodd in as a partner under an agreement that the profits of the sale of the franchises should be divided between them. They together organized the Missouri Light & Power company and made a transfer to it of the franchise, etc., received from the Westinghouse company, upon the condition that at least $100,000 par value of the stock of the new company should become the property of the promoters, to be divided between them in equal parts. The contract with the Westinghouse company was made in the name of parties other than Messrs. Dodd and Tredway. On the organization of the Missouri Light & Power company Mr. Dodd received stock to the value of between $100,000 and $250,000, and the plaintiff was left entirely out of the deal. He therefore asks for a division of the stock held by Mr. Dodd and a discovery of the stock of the company.

ELECTRIC RAILWAYS.

An electric railway is to be built at Saxton River, Mass., in the spring.

The Sioux City, Iowa, and Leeds Electric Railway company will erect a permanent power plant to supply its lines.

A new electric road is to be built from Norfolk, Va., to Ocean View. D. D. Phillips and others have obtained a charter.

Reitlinger & Francis have purchased the rolling stock of the Belle City, Wis., Railway company and will run an independent line between Northpoint and the Rapids.

The project for an electric street railway at Oskaloosa, Iowa, seems to have fallen through. The project was also to light the town and the town of Boone with electricity. The field is open for a company.

The Chester & Wilmington Electric Railway company will be incorporated. The company's road is to run from Wilmington to the state line near Claymont, there to connect with the Chester system extended.

The Peekskill, N. Y., Surface Railroad company has applied for a franchise to construct and operate an electric road in Peekskill, N. Y. The intention is to build a line from the railroad station up through the city, and also out to Verplanck's Point, to Hillside cemetery, to Lake Mohegan, and to the State Camp of Military Instruction. The road is to be running by the time the state camp season opens in June.

Now that Yonkers has its electric railroads and Sing Sing is to have one, the villages between these two places wish the trolley system extended so as to pass through Hastings, Dobbs Ferry, Irvington, Tarrytown, and Scarborough, and thus give the residents of these places rapid and cheap communication with each other and with Yonkers and Sing Sing. It has been confidently expected by Hastings and Dobbs Ferry that on the completion of the Warburton avenue extension and bridges the Yonkers electric railroad would run its cars to Dobbs Ferry at least, if not farther. But a complication has arisen in that the residents of these two villages object to car tracks in Broadway between Hastings and the Westminster school, because of their interference with driving on one of the choicest pieces of road in Westchester county, while the railroad company objects to buying a strip of private land a mile long on which to operate its system.

At a meeting of the board of aldermen of New Brunswick, N. J., last week, an ordinance giving a charter to the City Railway company to operate an electric road in New Brunswick provoked much discussion, and was passed over to the next meeting. There is a very general public sentiment in New Brunswick in favor of the measure. The proposed electric road will make a belt line around the city, and will connect with the station of the Raritan River railroad on Commercial avenue, and then run across town to French street. The prospect for a series of electric roads in Middlesex county seems very promising. The road from Somerville and Raritan to Bound Brook and Plainfield is an assured improvement. When the road to Bound Brook is completed it is expected that the New Brunswick railroad people will extend their line to that place, thus making a circuit of Somerville, Bound Brook, Plainfield, and New Brunswick. Right of way for many miles of the road has been already secured [illegible] understood.

A petition was introduced in the Massachusetts Legislature last week asking for the incorporation of the Boston Suburban Street Railway company to go from Boston to Lowell and from Boston to Newburyport or other points in the Merrimac valley, the former line to go through Somerville, Cambridge, Medford, Winchester, Woburn, Burlington, Billerica, Tewksbury, Dracut and Lowell, and the latter through Everett, Chelsea, Revere, Lynn, Swampscott, Salem, Beverly, Wenham, Hamilton, Ipswich, Bowley, Newbury and Newburyport, with the privilege of a circle route from Newburyport by West Newbury, Groveland, Bradford, North Andover, Andover, Wilmington, Reading, Wakefield, Stoneham, Woburn, Melrose, Malden, Medford, Arlington, Somerville and Boston. The petition was accompanied by bills incorporating the Boston Boynton Bicycle Railroad company, with a capital of $3,500,000, and several subordinate companies with smaller capitals. The system provided for is the Boynton bicycle plan for elevated railroads. The matter will go over to the next general court.

TELEPHONE.

The long distance telephone line connecting New York and Chicago with Detroit was opened on Saturday evening. Mayor Pingree of Detroit took part in the opening exercises.

Now that the original Bell patent is about to expire new telephone companies are springing up like mushrooms. One of the latest is the Western Telephone Construction company of Chicago. The incorporators are James Keelyn, George F. Stitch, J. F. Scanlan and Miles Kehoe. The company says that it expects to be a rival to those at present established. The Strowger automatic telephone exchange will be used.

TELEGRAPH.

At the annual meeting of the Chicago Telegraphers' Aid society the secretary's and treasurer's reports showed a membership of 280 and a balance in the treasury of $800. F. M. Crittenden was elected president and J. C. Barclay vice-president for the ensuing year, both of the Western Union. W. H. Mills and W. E. Griffiths, of the Postal Telegraph company, were re-elected secretary and treasurer respectively.

TRADE NEWS.

Pattern letters and figures to put the names, dates of patent, etc., on patterns of castings are made in endless variety, by H. W. Knight & Son. Address drawer S, Seneca Falls, N. Y.

The Clark Electric company of New York has issued a handsomely illustrated catalogue describing its system of electric lighting. This company makes a specialty of ornamental arc lamps, and it has introduced some very handsome designs.

The Electric Appliance company, Chicago, reports a lively and growing demand for its adjustable electrolier. The company announces that, judging from the way the orders come in, it bids fair to displace the old style cord adjusters.

It is announced that the F. E. Belding Mica Mining company of Boston, Mass., has found it necessary to secure larger quarters with better facilities for handling its business. This company has secured a store at 12 Broad street near State, and will have first-class facilities hereafter.

Messrs. Cushing and Morse, general western agents for Day's kerite wires and cables, 225 Dearborn street, Chicago, report a number of good orders recently received from the far West, among which is a 52 conductor cable to be laid in Puget sound and two 50 conductor cables to cross the Willemette river.

The National Indian Rubber company of Bristol, R. I., manufacturer of N. I. R. wires, has opened an office at 487 Broadway, corner Broome street, New York, with H. L. Burdick manager. The company is extending the field of its operations and is receiving gratifying evidence of the appreciation of its patrons.

The General Electric company announces that during one week in January its motor sales were one fifth of the whole number sold in the preceding year. The company's works at Lynn are running full time in all departments again after the partial shut down for stock taking. An improved motor and power generator are said to be about ready to be put on the market.

Captain John A. Grier has recently become associated with the Ansonia Electric company, and is at present at the company's factory in Philadelphia, where he is familiarizing himself with the Helios arc lamp for alternating circuits, with a view of introducing it to the western trade. The Ansonia company has arranged for the western selling agency of this lamp. It is a focusing lamp and is claimed to be the only arc lamp that has been constructed to successfully operate on an alternating circuit. With the Stanley transformers and the Helios arc lamp, the Ansonia Electric company has a combination to win friends with every central station operating an alternating machine.

The Illinois Electrical Forging company has just been incorporated with a capital of $2 000,000. Walter G. Campbell of San Francisco is president, L. D. Kneeland vice-president, and John P. Skinner of New York, secretary and treasurer. The offices will be in the Title &

Trust building, No. 100 Washington street, room 401, Chicago, Ill. The company will do all kinds of electrical forging, smelting and welding and will have a factory at West Pullman. Mr. Campbell, the president, has been interested for the last few years in mining in the far west and has valuable experience with the ores. Mr. Kneeland, the vice-president, is also vice-president of the West Pullman company and a large stockholder.

In view of the fact that the ordinary house annunciator does not fully answer the purpose for which it is designed, as servants and others will not trip or restore the drops, needles or other indicating mechanism, and hardly ever know from which room or locality the call proceeds, the Partrick & Carter company, of Philadelphia, has devised an automatic set-back annunciator for use in houses. In this system only one, and that the last, call remains pointing or indicating; each new call resets the pointer that indicated the previous call. No attention to the annunciator other than observing the dial when the call comes in is required. In appearance the new device resembles the King, one needle giving two indications, except that the resetting knob is dispensed with. The mechanism of the instrument is simple and the device needs no attention or experience on the part of servants.

Barton L. Peck of Detroit notes in a communication to the Massachusetts Chemical company of Boston an interesting case in which considerable trouble was experienced with a commutator. The cause of the trouble was the soaking of oil into the insulation and burning there, causing short circuits. Mr. Peck insulated the commutator with canvas specially prepared for the purpose. The canvas was treated with a thin coat of insullac and well dried. Then it was cut up and placed in the commutator ends and the edges trimmed down flush with the collar. The commutator was thoroughly heated and while in that condition a heavy coat of insullac was applied to all exposed parts and allowed to dry hard before the machine was started. This testing removed the cause of trouble and the machine has since been operated satisfactorily.

BUSINESS.

The Electrical Engineering & Supply company, St. Paul, Minn., has issued a comprehensive catalogue illustrating and describing its numerous specialties.

Okonite wire has been specified for the Congress Hotel, Chicago, the new annex to the Auditorium. Okonite wire was selected upon its merits, the Auditorium having had a varied experience with other wires, and a practical demonstration of the superior lasting qualities of Okonite.

The Riehle Bros. Testing Machine company announces that beginning April 1st J. R. Matlack, Jr., will act as its representative at the World's Columbian Exposition, and can be found, previous to the opening of the exposition, at the office of R. W. Hunt & Co., Rookery, Chicago, Ill.

A circular has been sent out to the trade by the Detroit Dynamo company of Detroit, Mich., calling attention to the superior features of its new dynamos for arc and incandescent lighting, electro plating, and copper refining. This company makes a specialty of an electro plating machine.

Following are some of the new buildings in St. Louis recently equipped with the interior conduit system: Rialto building, Columbia building, Mercantile club, St. Nicholas Hotel, Security building, Union Trust building, Planter's hotel. The Southern Electrical Supply company reports that architects in St. Louis appear to be favorably impressed with the merits of this system.

F. W. Horne of the railway department of the western office of the General Electric company has just closed a contract with the Central Railway company of Peoria, Ill., for the electric power equipment of the road. The outfit for the Central railway will consist of nine double 25 horse power W. P. motor and car equipments. Mr. Horn also sold this company three 400 horse power multipolar generators.

The C. & C. Motor company through the Chicago office has sold a 100 horse power direct current motor for driving a mill in the far West. This is believed to be the largest motor ever installed in America on a constant potential circuit together with a number of others. There are in addition to this, running on the same circuit, seven more motors of 10, 25 and 30 horse power. The current is obtained from a central station plant.

The announcement is made by Manager C. A. Phillips of the Pioneer Armature Works, 192 South Canal street, Chicago, that that establishment is now doing a rushing business. The Pioneer Works at the present time are well equipped for all sorts of repair work, new machinery having just been added. The Pioneer Works are now in a position to repair and rewind armatures for street car motors and generators as well as those for electric light machines.

The Phillips Insulated Wire company of Pawtucket, R. I., will hereafter have its headquarters at 39 and 41 Cortlandt street, New York which will be occupied by the new president, H. C. Adams, and his assistants. This company will manufacture all kinds of insulated wire, such as triple braided weather proof, damp proof office wire, etc., and has adopted as its trade mark "O. K.," letters standing out in white colors on a black back ground. Mr. Adams, the president of the company, is quite widely known in electrical circles. For the last few years he has been the eastern manager of the Fort Wayne Electric company, and prior to that time was connected with the American Electric Manufacturing company. But Mr. Adams is more widely known as an electric wire man than in any other capacity. In 1867 he first entered the electric wire business, becoming at that time connected with Holmes, Booth & Haydens. This long experience in the electric wire business will make Mr. Adams and his company very strong factors in the industry in this country.

McLean & Schmitt, 197 South Canal street, Chicago, have just installed an ingenious electrical advertising device in the show window of the Emporium, 152 State street. The contrivance consists of a wheel upon the periphery of which are arranged a number of incandescent lamps of different colors. This wheel is revolved at about 300 revolutions per minute by a small electric motor. Through the aid of an ingenious commutating device the wheel is made to appear as a ring of fire which changes color every half minute. There are about twenty-five color combinations. The whole rigging outside of the wheel occupies a space of about 1½ square feet. McLean & Schmitt, in addition to their repairing business, make a specialty of such advertising devices.

ELECTRICAL PATENTS.

Issued February 14, 1893.

491,531. Electrical Signaling Apparatus. Jacob B. Currier, Lowell, Mass.

The invention comprises means for regulating the strength of a current supplied by a battery to maintain it constant. The circuit passes between a pair of normally closed contact points, one of which is stationary, while the other is carried upon the armature of an electro-magnet included in the circuit. When the current tends to increase, the armature is attracted, thus separating the contact points slightly to introduce an air bridge in the circuit, and thus increase the resistance.

491,532. Electric Governor for Signaling Circuits. Jacob B. Currier and David H. Rice, Lowell, Mass.

491,548. Electric Arc Lamp. Frederick D'A. Goold, Schenectady, N. Y.

The carbons normally rest out of engagement, and a single magnet is provided, which is placed in shunt with the carbons. The upper carbon rod, which is the movable one, is normally held from feeding by a clutch suspended from one end of a lever, to the other end of which is attached the weighted armature of the magnet. When current traverses the lamp, the shunt magnet is energized, thus attracting its armature, the motion of which brings the carbons together. A circuit of low resistance being thus closed, the shunt magnet is de-energized and the descent of the weighted armature raises the upper carbon rod, thus establishing the arc. During the burning of the lamp, when the arc becomes abnormally long, the shunt magnet is energized to attract its armature, thus permitting the carbon rod to feed until the resistance of the arc is properly decreased, when the current through the shunt magnet being insufficient to retain the armature in a raised position the latter falls, thus locking the carbon rod in position.

491,553. Trunk Line Signaling Apparatus and Circuit for Telephone Exchanges. Edward J. Hall, Morris, N. J.

491,560. Coulomb Counter. George Hummel, Nuremberg, Germany.

The counter comprises an electric motor, the stationary field coils of which are traversed by the current to be measured, and the movable armature coils of which are in shunt with the field coils. A damping device, consisting of a disk of conducting material, is driven from the armature shaft, and is acted upon by electro-magnets included in the circuit to be measured, the connection between the damping device and the armature being rigid. The registering device is in positive connection with the damping device.

491,561. Incandescent Lamp Socket. Joseph Hutchinson, New York, N. Y.

491,567. Conductor for Armatures. Emil Kolben, Schenectady, N. Y.

The conductor is designed for armatures in which currents of large volume are induced, and, in order to prevent the formation of eddy currents, the conductors are provided with saw kerfs lying in radial planes, thus presenting narrow faces to the pole pieces.

491,568. Armature and Means for Supporting the Same. Emil Kolben, Schenectady, N. Y.

491,580. Escaping Gas Alarm. Charles J. Milligan, Chicago, Ill.

491,595. Telegraph Transmitter. Robert S. Roberts, Philadelphia, Pa.

491,596. Electric Lamp Fixture or Bracket. James T. Robb, Mount Vernon, N. Y.

491,603. Duplex Electric Arc Lamp. Charles E. Scribner, Chicago, Ill.

Two lamps are connected in multiple arc in the same circuit and a shunt is provided about both lamps, and contains the cut-outs of both lamps, so that the lamp in which the arc is first formed serves to open the shunt circuit. Each lamp is provided with a circuit closing device controlled by its lifting mechanism, the contact points of each circuit closing device being placed reciprocally in that part of the multiple circuit leading to the carbons of the other lamp, so that the movement of the lifting mechanism of one lamp will hold open the circuit of the other lamp.

491,604. Electric Arc Lamp. Charles E. Scribner, Chicago, Ill.

Yielding guides are provided for the upper carbon rod, and upon one of the guides is provided one of the contact points of a pair, and when at any time the yielding guides support the whole or any considerable amount of the weight of the upper carbon rod the guides yield to permit the closing together of the contact points. The contact points are included in a shunt circuit about the carbons, and when closed serve to shunt the lamp out of circuit.

491,605. Cut out for Arc Lamps. Charles E. Scribner, Chicago, Ill.

An electro-magnet is included in series with the carbons of the lamp, and under normal conditions of the burning of the lamp is sufficiently excited to attract its spring pressed armature to maintain a short circuit about the carbons open. When the current through the carbons materially decreases the armature is released to close the short circuit, in which is placed a resistance. The closing of this short circuit breaks the arc, thus de-energizing the feeding magnets and permitting a permanent short circuit containing no resistance to close.

491,609. Track Circuit. Joseph B. Stewart, Haverstraw, N. Y.

491,666. Electric Locomotive. Sidney H. Short, Cleveland, O.

The motor is supported upon the axle of the truck, and is connected at one point with the frame of the truck through a buffer. The field coils are two in number, and placed one upon each side of the armature, and are adapted to supply lines of force to a number of pole pieces. Between the axle of the truck and the felloe of the wheel is interposed an insulating and cushioning material. The armature of the motor is geared directly to the wheels.

491,667. Directly Connected Motor for Cars. Sidney H. Short, Cleveland, O.

491,682. Bushing for Incandescent Lamp Sockets. Cromwell A. B. Halvorson, Saugus.

The bushing consists of a cork provided with a longitudinal opening to permit the passage of the conductor cord, the yielding character of the cork preventing the cutting of the cord conductor.

491,684. Manufacture of Secondary Battery Electrodes. Robert McA. Lloyd, New York, N. Y.

The process of manufacture consists in subjecting a plate to the action of a solution which is acid in the beginning, and which afterward becomes alkaline, thereby first producing honeycombs in the surface of the plate, and subsequently chemically depositing on the plate active material and afterward forming the plate by passing an electric current through it.

491,686. Ore Amalgamator. Fred O. Norton, Clinton, Ia.

491,688. Switching System for Telephone Exchanges. Charles E. Scribner, Chicago, Ill.

Each busy or frequently called subscriber's line is connected with a line spring jack upon each section of a multiple switch-board system, and with an answering jack and an individual annunciator upon some one section of the switch-board as heretofore. The remainder of the lines, the seldom called for lines, are connected with line springs upon a separate switch-board, and with answering jacks and annunciators upon some section of the main multiple switch-board. Transfer or trunking systems are provided, extending from the various sections of the main switch-board to the auxiliary switch-board, by means of which connection may be established from any line a the main switch-board to the auxiliary board.

491,691. Series Systems for Railways. George L. Thomas, Brooklyn, N. Y.

The supply conductor is composed of relatively insulated sections, which are normally in electrical connection through a pair of rollers which rest in contact, and are in electrical connection respectively with the adjacent ends of the insulated sections. Upon the car is carried a bar composed of metallic plates separated by insulation, the motor being connected between the two plates. As the car progresses the bar, which is pointed at the ends, passes between the rollers, thus separating them and bringing the motor in series with the supply conductor. The rollers are placed at such a distance apart that the bar makes connection with one pair of rollers before the connection with the preceding pair is broken.

491,692. Time Circuit Closer. Robert H. Twigg, London, Eng.

491,695. Alternating Current Dynamo-electric Machine. James J. Wood, Brooklyn, N. Y.

491,700. Method of Electrolytically Producing Soda and Chlorine. Elisha B. Cutten, New York, N. Y.

491,701. Method of Electrolytically Producing Potassium Chlorate. Elisha B. Cutten, New York, N. Y.

491,707. Electrical Insulating Conduit. Charles W. Jefferson, Schenectady, N. Y.

491,708. Electric Motor and Dynamo Mica Insulator. Charles W. Jefferson, Schenectady, N. Y.

491,713. Electric Head Lamp. William Main, Brooklyn, N. Y.

491,726. Accumulator. William A. MacLeod, Boston, Mass.

491,729. Insulator. Louis McCarthy, Boston, Mass.

491,758. Electric Signaling Apparatus. Ludwig von Orth, Berlin, Germany.

491,777. Memorandum Tablet for Telephones. William M. Kleeman, Columbus, O.

491,811. Alternating Current Generator. Octave Patin, Paris, France.

491,824. Electric Alarm Money Drawer. William J. Walker, St. Louis, Mo.

491,829. Electric Motor Regulator. Joseph A. Williams, Canal Dover, O.

491,837. Railway Train Order and Signaling Device. Leonard T. Crabtree, New London, Wis.

491,857. Electric Locomotive. Frank B. Rae, Detroit, Mich.

The motor is carried between the two axles of the truck, and occupies a position in which its armature shaft is perpendicular to the wheel axles. Upon each end of the armature shaft is provided a bevel pinion, the pinions meshing with bevel gears upon the car axles.

491,874. Electric Signal. Frank H. Clarke, Springfield, O.

491,878. Secondary Battery. Nathan H. Edgerton, Philadelphia, Pa.

491,890. Insulator. Andrew L. Johnston, Richmond, Va.

491,893. Telephone Call. John H. Kinsman, Bridgeport, Conn.

491,916. Electric Arc Lamp. William H. Akester, London, Eng.

491,915. Electric Arc Lamp. William H. Akester, London, Eng.

491,945. Self-winding Electric Clock. Emil Klahn, West Hoboken, N. J.

491,970. Electric Motor. Alexander W. Meston, St. Louis, Mo.

EUGENE F. PHILLIPS, Prest. W. A. HATHAWAY, Treas. W. H. SAWYER, Sec'y.

AMERICAN ELECTRICAL WORKS,

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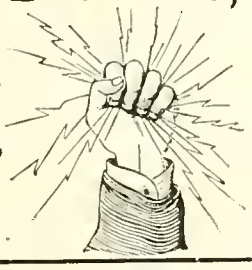
RAILWAY FEEDER AND TROLLEY WIRE,

ELECTRIC LIGHT LINE WIRE,

Incandescent and Flexible Cords,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



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FOR ELECTRICAL USES.

Graphite Rods of Various Lengths, from 1-5 Ohm to 100 Ohms Resistance to the Inch. Graphite Boxes and Crucibles, Resisting Heats of 4,000 Degrees. Inquiries Gladly Answered.

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THE "CLARK" WIRE.

TRADE MARK.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

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EASTERN ELECTRIC CABLE CO.,

61 to 65 Hampshire Street, BOSTON, MASS.

HENRY A. CLARK, Treasurer and Gen'l Manager.

HERBERT H. EUSTIS, President and Electrician.

A LONG FELT WANT SUPPLIED.

WRITE FOR PRICES AND SAMPLES OF

"Crescent" Overhead Line Wire. It will Surprise You.

THE CRESCENT INSULATED WIRE & CABLE CO.,

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ANY CANDLE POWER. **THE** **ANY VOLTAGE.**

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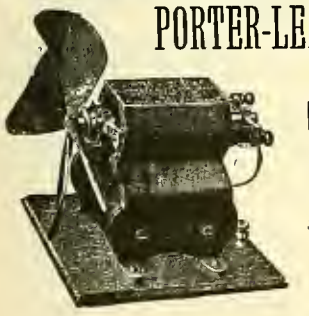
Write for Prices. **Samples Free.**



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FAN and BATTERY MOTORS

—A SPECIALTY.—

FOUR REGULAR SIZES.

Suitable for running Sewing Machines, Dental Drills, Jewelers' Lathes and all kinds of light machinery.

No. 1, 2 Volts, 1-32 h. p., $3.00.
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Every Motor Guaranteed. Send for Circular

ENGINE CASTINGS

from one-eighth to six horse power Horizontal and Marine.

8, 16 and 60 LIGHT DYNAMO CASTINGS.

Simple Sewing Machine and Fan Motor Castings with instructions for building complete machines. Send Stamp for Catalogue.

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Guaranteed Over 99 Per Cent. Pure.

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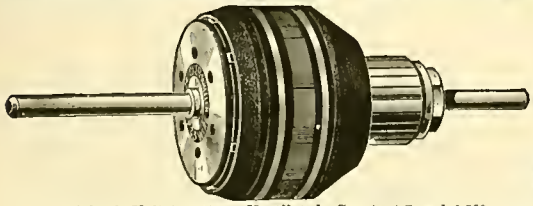

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¼ H. P. 500 Volt Armature, Ventilated. Constant Speed, 1,500.

The Motors are made with the best appliances and material obtainable, and embody every improvement of merit, with the intention that they shall be the Standard of their class.

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Portable Standard Testing Resistance Set.

It can be used under every condition of practical work, and is the only instrument of its class unaffected by magnetic fields or mechanical jars.

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NEARLY EVERYONE

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HAVE YOU?

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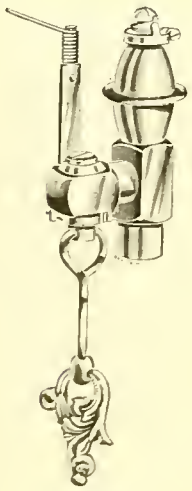

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It is safe, convenient, always in order, never runs the battery down, never leaks, saves dollars in repairs over all others.

SEND FOR SAMPLE ORDER.

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TRADERS IN ELECTRICAL MACHINERY.

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Two 30 light Ball arc dynamos, with 60 arc lamps.
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One 80 light Mather incandescent dynamo, 110 volt.
One 8 horse power Card motor, 500 volt.

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Permanent position at good salary open for a first-class Motor Salesman. Please state experience and give references.

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An experienced man to take charge of experimental department of large electrical works. Must be a first-class mechanic, thoroughly conversant with Telephone, Telegraph, Medical Battery and General Electric Work, and competent to develop articles and put them on a commercial manufacturing basis. Address, "Foreman,"
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Shepard's Celebrated $60

Screw Cutting Foot Lathe,

Foot and Power Lathes
From 9 to 26 Inches.
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ENGINES Over 2000 in Service. Simple or Compound. Send for Cir

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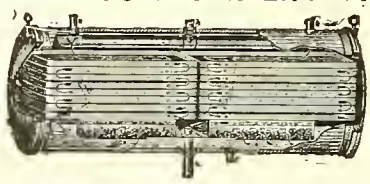

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With Manufacturing Co., or as Superintendent or Manager of a Central Station or Electric Railway, in a growing town, by an energetic young man for 5 years engaged as expert by the Edison Co., and having a large practical and theoretical experience in all kinds of electrical work. Thoroughly competent to take charge of work and handle a force of men economically. Have the best of references.

Address **"ELECTRICIAN,"**
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CITY CLERK'S OFFICE,
EAU CLAIRE, WIS.

Sealed proposals will be received at the office of the City Clerk, of the city of Eau Claire, Wis., up to six o'clock p. m., March 15, 1893, for lighting the City of Eau Claire, after the 27th day of July, 1893, according to the specifications now on file in the office of the City Clerk, the Council, however, reserving the right to reject any and all bids. Any party to whom the contract may be awarded will be given a franchise that will enable him or them to do a general electric lighting business in the City of Eau Claire, for a period of 20 years, on terms that will enable them to compete fairly and evenly with the only company now engaged in electric lighting in the City of Eau Claire.

F. R. DOUGHERTY,
Feb. 17, 1893. City Clerk.

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Dry Battery.

Write for Particulars and Prices.

Manufactured by

Columbia Mfg. & Supply Co.,

340 & 342 Dearborn St.
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Manufacturers of
OCTAGONAL AND CEDAR
TELEPHONE & ELECTRICAL
RAILWAY POLES & CROSS ARMS
THE H. M. LOUD & SONS LUMBER CO.
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A position as draughtsman, lineman, or any thing in Electrical line—object experience—by a graduate (E E) of a leading technical University. Good references. Address E. E.,
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Position as Superintendent of central station, or would accept a position to take charge of construction work, having had six years experience in construction of central stations and isolated plants, and four years as mechanical engineer. Can furnish first-class references, and would accept a salary of $100 per month. Address

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Two 300-amperes shunt wound U. S. Dynamos.
Two 200-amperes shunt wound U. S. Dynamos.
Two 500-light T.-H. Dynamos, compound wound, with Base, Rheostat and Ammeter.
Two 25-light American 2,000-c. p. Arc Dynamos.
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Ten 12-light Knowles Dynamos with lamps.
Twelve 50-light Schuyler Dynamos, 2,000-c. p.
Two 150-Brush Incandescent Machines, 95 volts.
One 15-light Brush Arc, 7 amperes.
One 90-h. p. Armington and Sims Engine.
Two 120 ampere Edison Dynamos, self-oiling.

We Buy Outright Electrical Equipment.

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ARMATURES REWOUND.

Street Railway and Electric Lighting Companies will find it to their interest to write for prices, as we do all kinds of electrical repair work.

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Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

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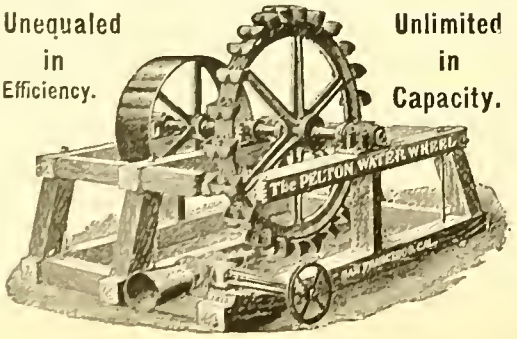

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Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 20 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

ELECTRIC TRANSMISSION.

The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

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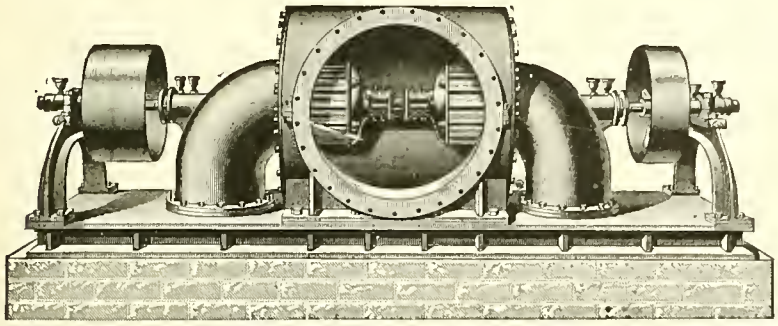
143 LIBERTY STREET, - - NEW YORK.

☞ It having come to our notice that our patent rights are being infringed upon, intending purchasers are hereby warned that all such infringements will be duly prosecuted.

PELTON WATER MOTORS. Varying from the fraction of 1 to 15 and 20 horse power, unequaled for all light running machinery. Warranted to develop a given amount of power with one-half the water required by any other. ☞ Send for Motor Circular. Address as above. Deliveries made from San Francisco or New York, as may afford the most favorable freight rates.

VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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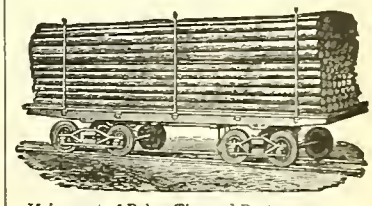

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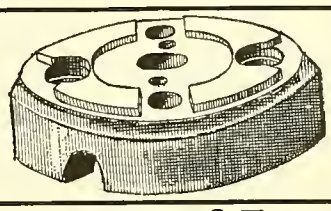

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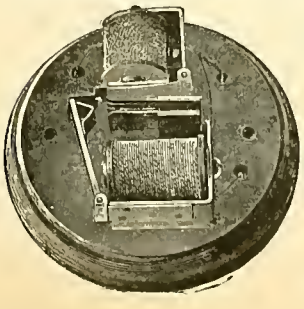

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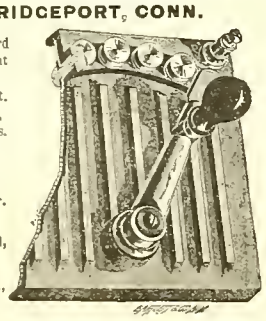

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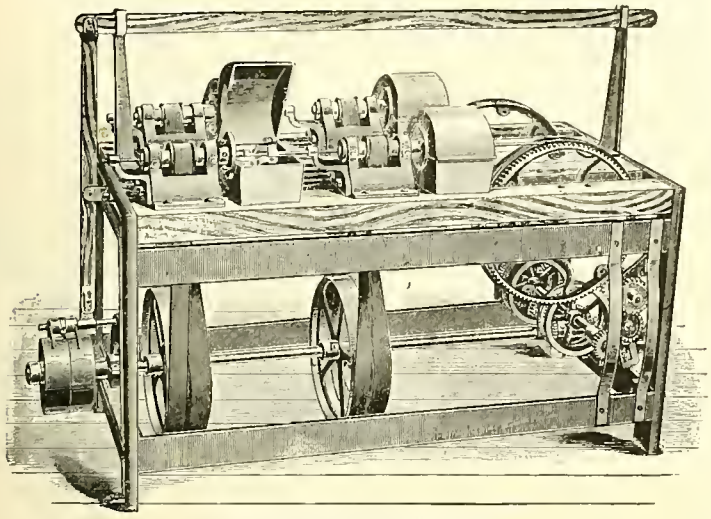

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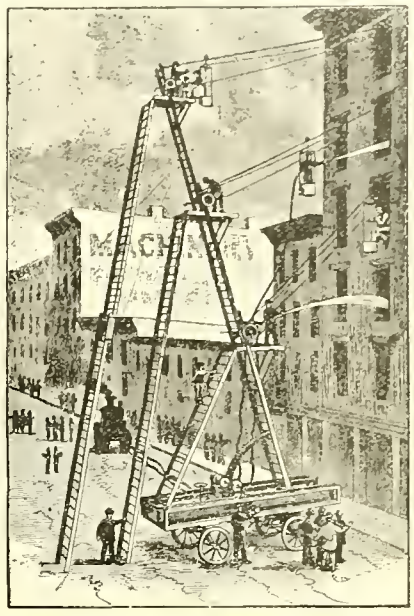

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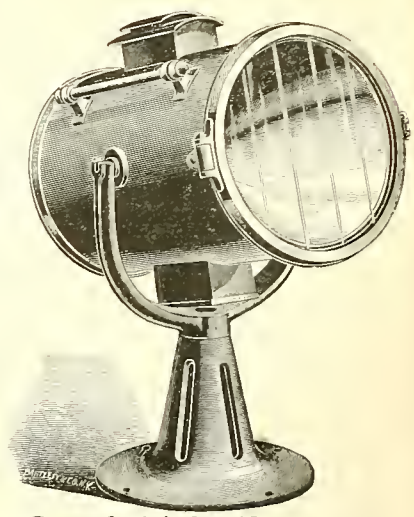

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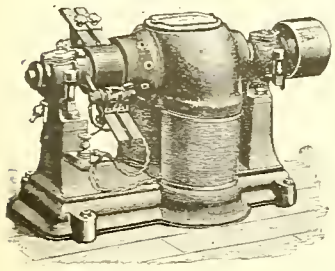

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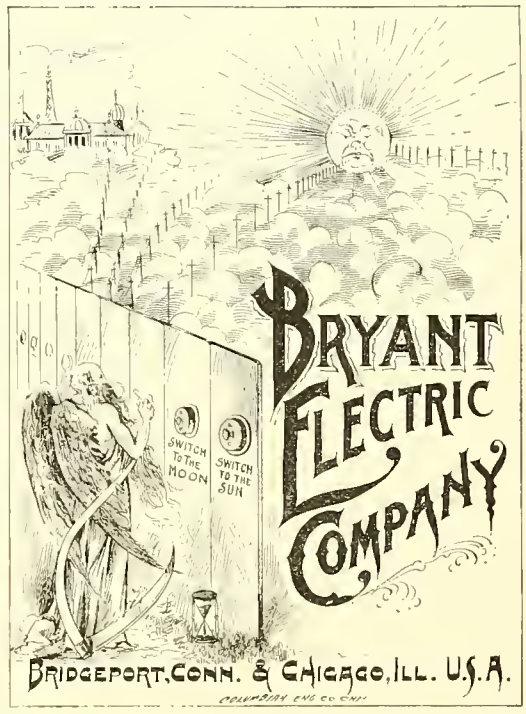

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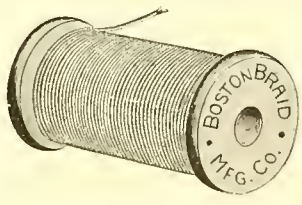

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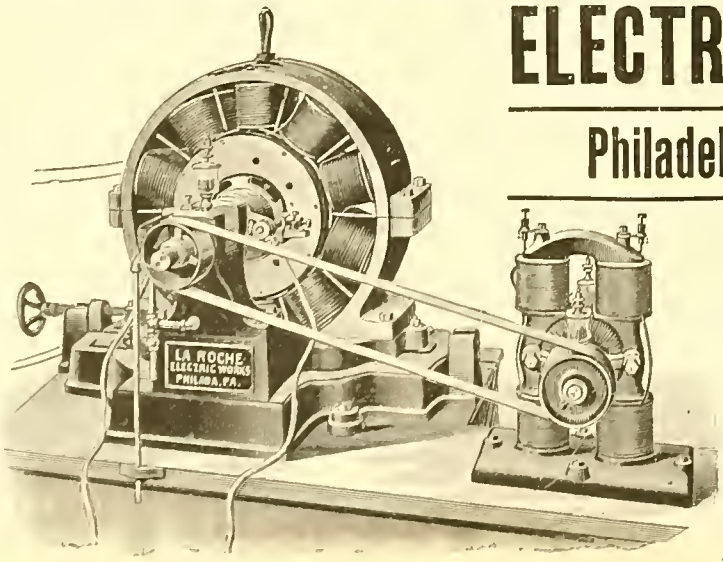

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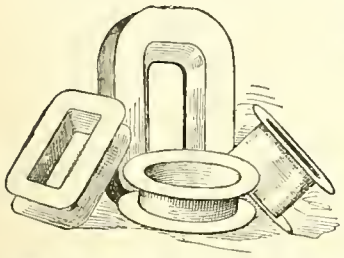

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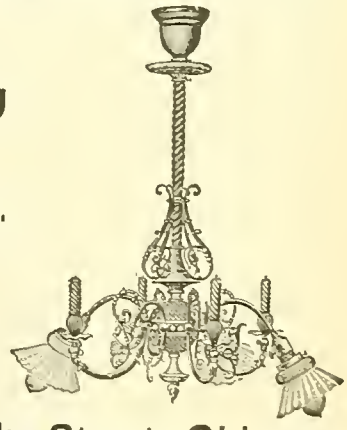

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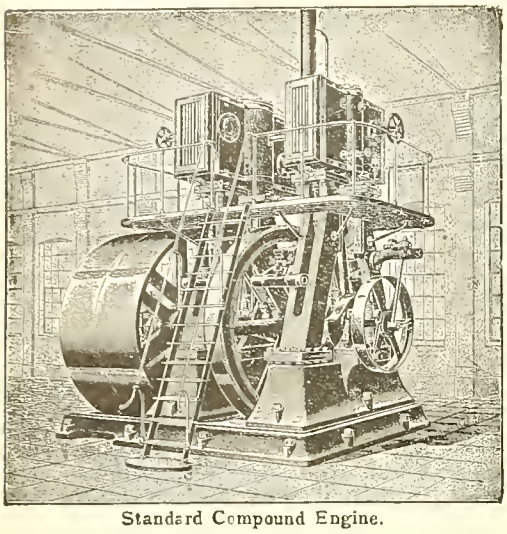

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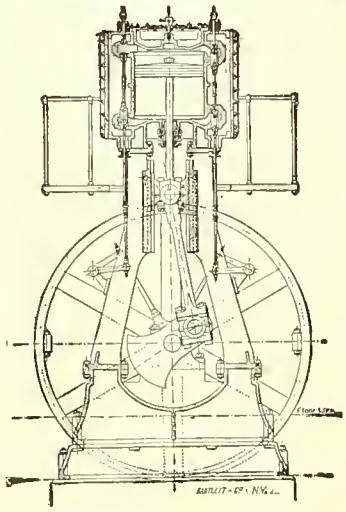

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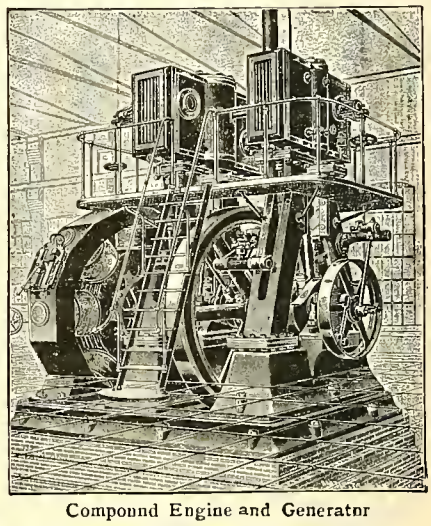

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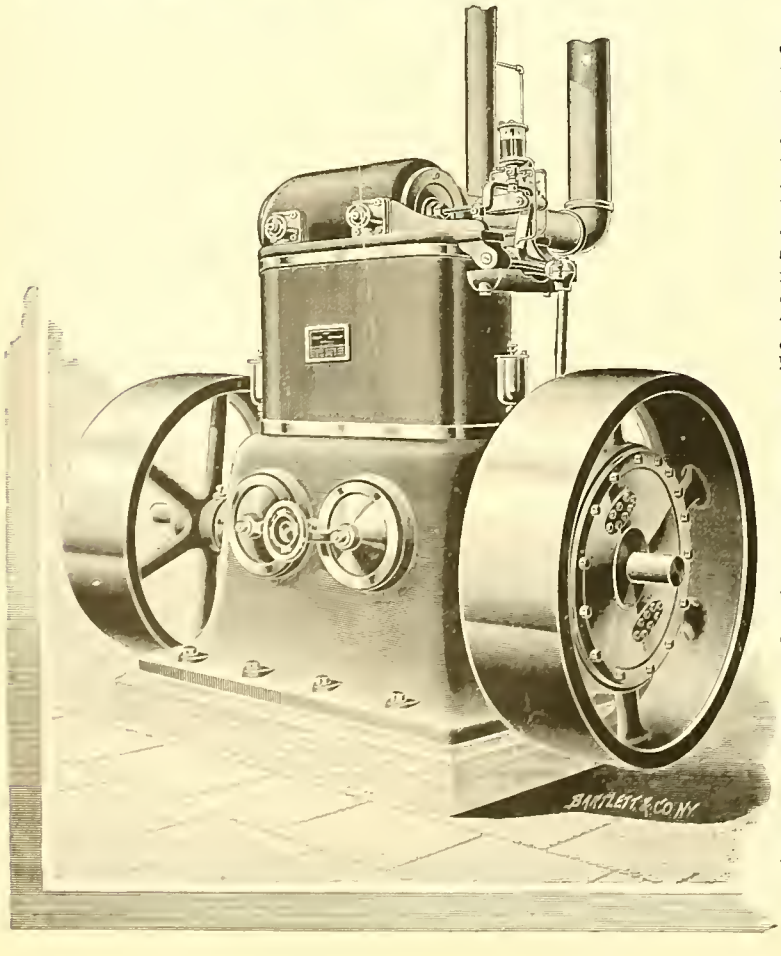

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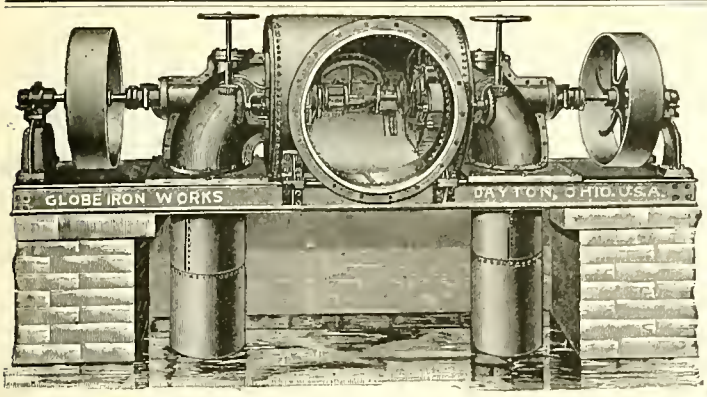

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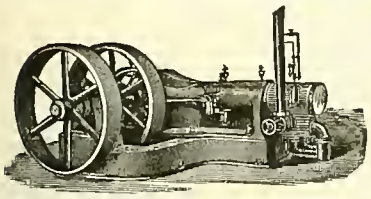

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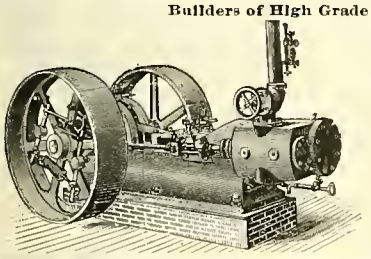

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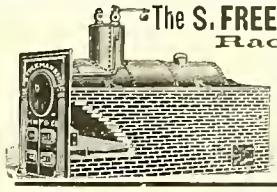

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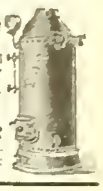

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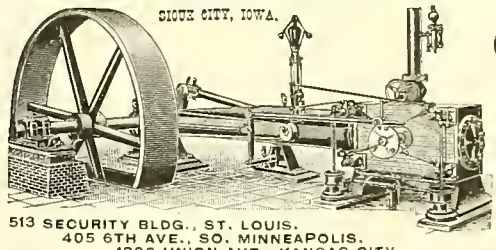

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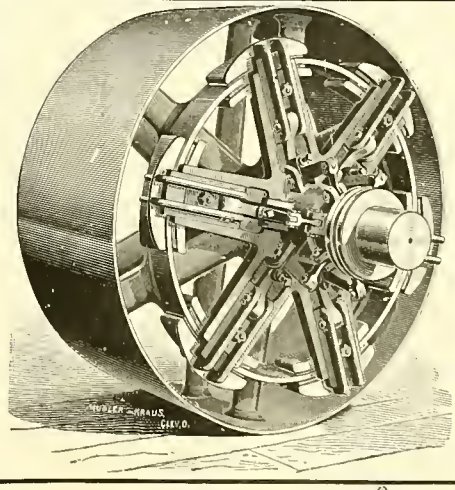

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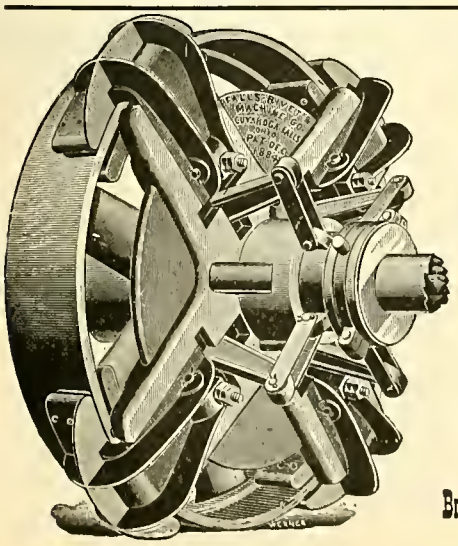

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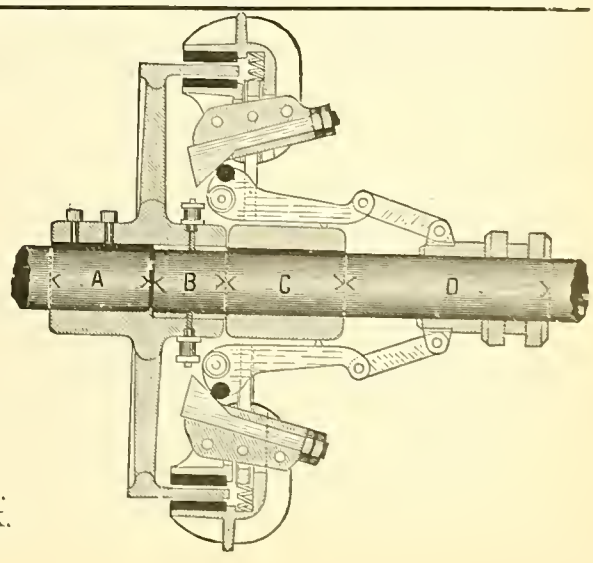

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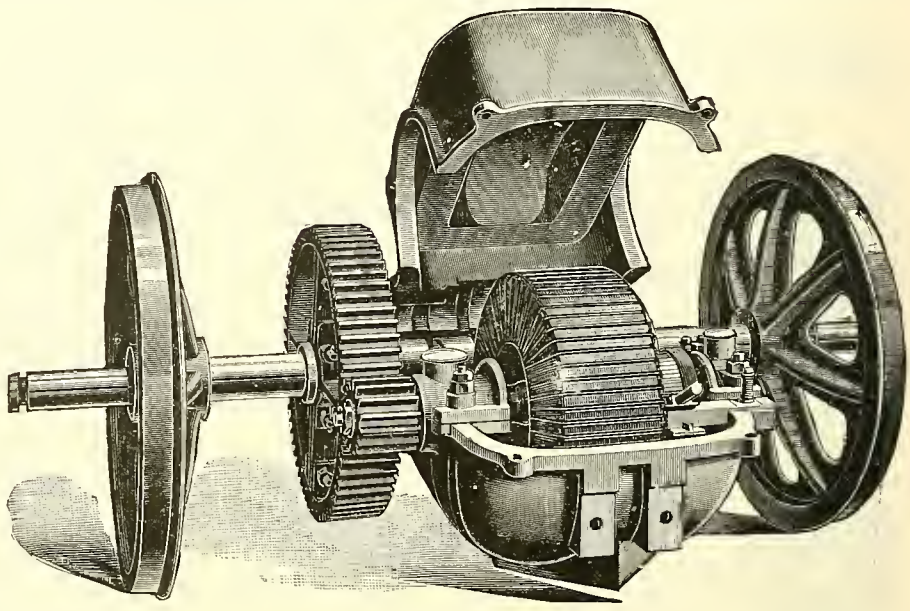

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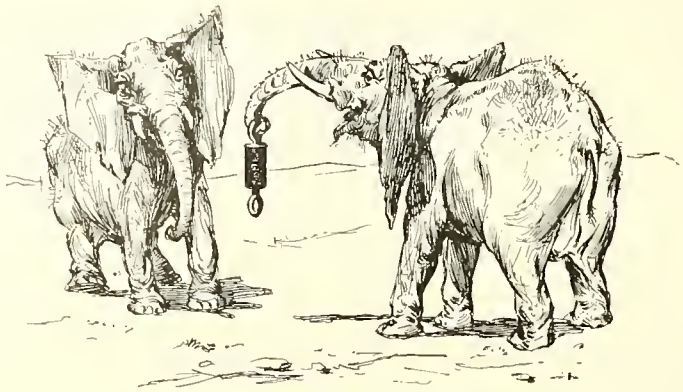

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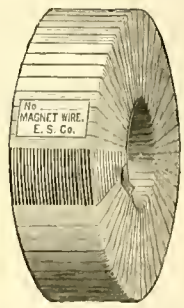

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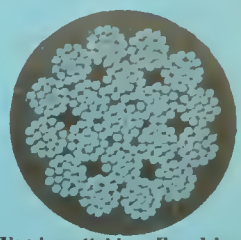
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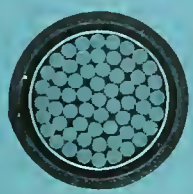
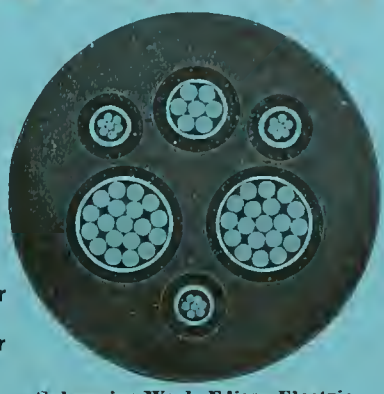
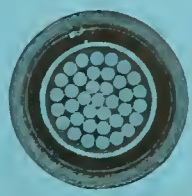
Underground Core, N. J. Central R. R.


Feeder Core, Broadway Theater.


Submarine Work, Edison Electric Light Co., Easton, Pa.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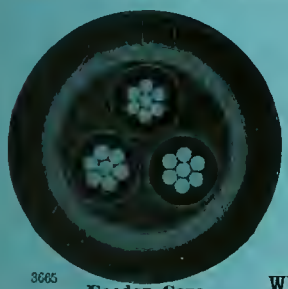
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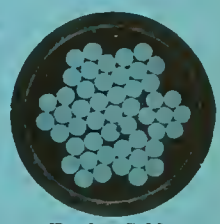
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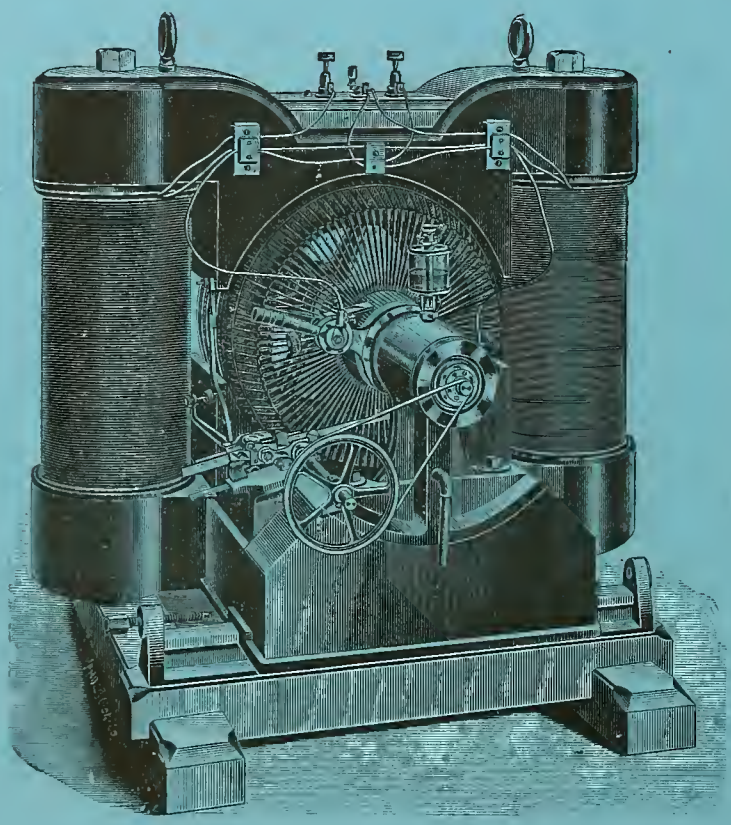

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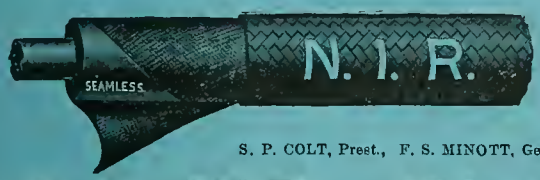

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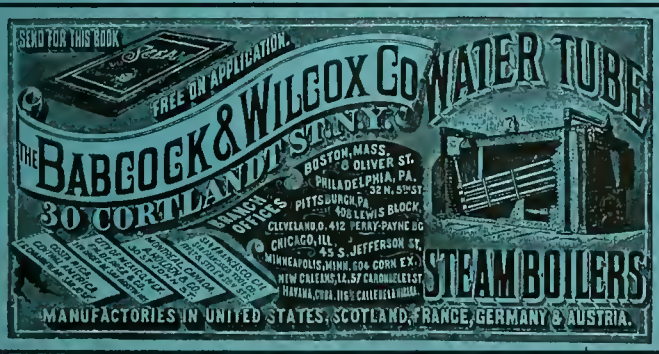

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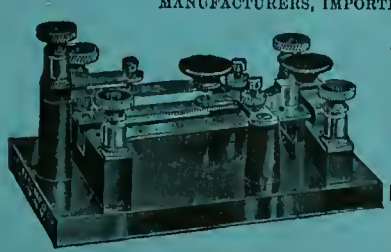

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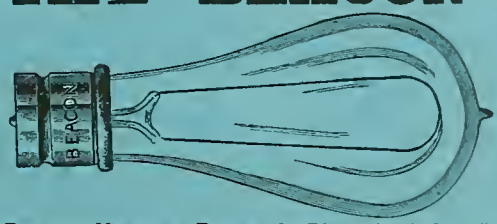

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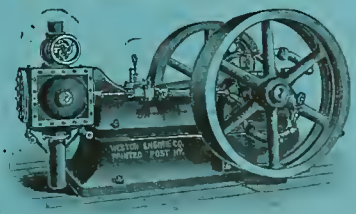

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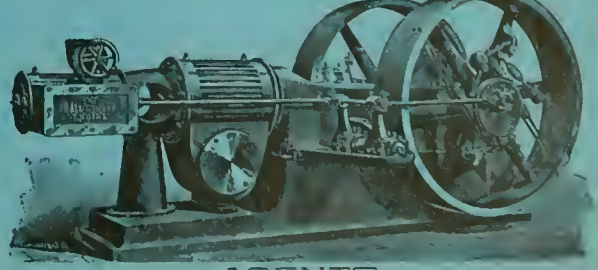

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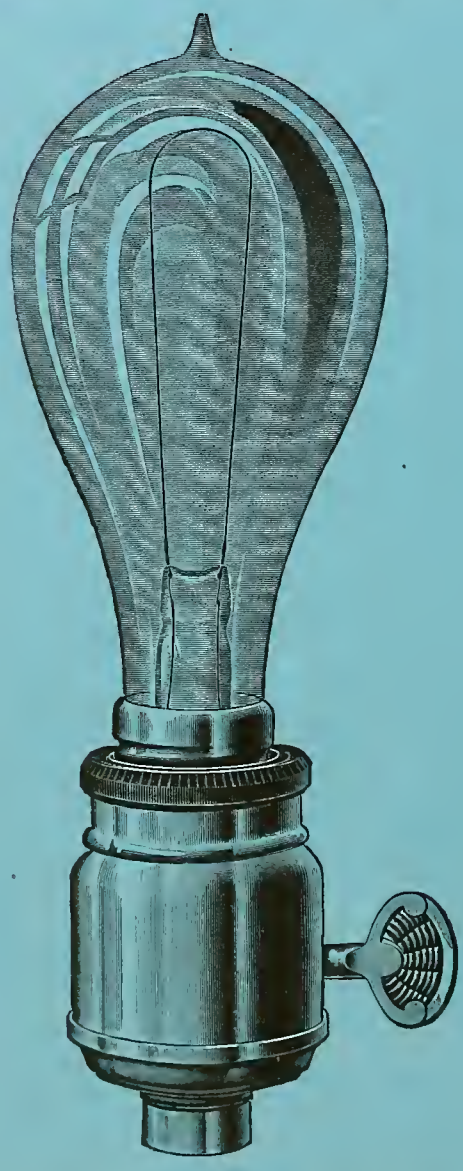

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See decision of U. S. Circuit Court of Appeals in case of Edison Electric Light Co. and Edison General Electric Co., against Sawyer-Man Electric Co., decided December 15, 1892.

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CLASSIFIED LIST.

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Ansonia Electric Co., The
Central Electric Co.
Knapp Electrical Works.
Ostrander & Co., W. R.
Partrick & Carter Co.

Arc Lamps.
Begge, J. E., Mchy. & Supply Co.
Duplex Electric Co., Ltd.
Electric Cons. & Supply Co.
General Electric Co.
General Incandescent Arc Lt. Co.
Knapp Electrical Works.
Mosher Electric Co.
Rose Electric Light Supply Co.
Siemens & Halske Electric Co.
Standard Electric Co.
Turbayne-Tamblyn Co.
Waterhouse, Gamble & Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Knapp Electrical Works.
Samson Cordage Works.

Batteries.
American Battery Co.
Ansonia Electric Co., The.
Columbia Mfg. & Supply Co.
Ford Washburn Storelectro Co.
Franklin Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Leclanche Battery Co., The.
Partrick & Carter Co.
Pumpelly-Sorley Storage Battery Co
Western Electric Co.
White, S. S. Dental Mfg. Co.

Battery Jars.
American Battery Co.
Butler Hard Rubber Co.
Central Electric Co.
Knapp Electrical Works.
Leclanche Battery Co., The.
Western Electric Co.

Bells, Electric.
Ansonia Electric Co., The.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Chicago Rawhide Mfg. Co.
Jewell Belting Co.
Link Belt Machinery Co.
Page Belting Co.
Shultz Belting Co.

Boilers.
Babcock & Wilcox Co., The.
Blanchard, Albert.
Freeman Sons Mfg. Co., The S.
Lane & Bodley Co., The.
N. Y. Safety Steam Power Co.
Weston Engine Co.

Books, Electrical.
Electrician Publishing Co.

Braiding Machinery.
New England Butt Co.

Burglar Alarms.
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.

Cables.
(See Insulated Wires.)

Cables, Electric. (See Insulated Wires), **Copper, Sheet and Bar**
Bishop Gutta Percha Co
Eastern Electric Cable Co.
Moore, Alfred F.
Roebling's Sons Co., J. A.
Washburn & Moen Mfg. Co.
Western Electric Co.

Carbons, Points and Plates.
Central Electric Co.
Knapp Electrical Works.

Castings.
Palmer Bros

Clutches, Frictina.
Falls Rivet & Machine Co.
Hill Clutch Works.

Cordage.
Samson Cordage Works.

Construction and Repairs.
Comstock, Louis K
McLean & Schmitt.
Pioneer Armature Works.
Roberts, E. P. & Co.
Western Electric Co.
Wilson & Jackson.

Contractors, Electric Light, Engine Plants and Electric Railways.
American Engine Co.
Babcock & Wilcox Co., The.
Ball & Wood Co., The.
Brush Electric Co.
C. & C. Electric Motor Co.
Cabell, L. Breckinridge.
Commercial Electric Co.
Comstock, Louis K.
Eddy Electric Mfg. Co.
Ford Washburn Storelectro Co.
Fort Wayne Electric Co.
Freeman Sons Mfg. Co., The S
General Electric Co.
Great Western Mfg. Co.
Heisler Electric Co.
Lake Erie Engineering Works.
Morse & Co., A. M.
N. Y. Safety Steam Power Co.
Osborne Steam Engineering Co
Pearson & Co., W. B.
Racine Hardware Mfg. Co.
Rockford Electric Mfg. Co.
Siemens & Halske Electric Co.
Sioux City Engine Works.
Standard Electric Co.
Waddell-Entz Company.
Westinghouse Electric & Mfg. Co.
Westinghouse, Church, Kerr & Co.
Western Electric Co.
Weston Engine Co.
Wilson & Jackson.

Copper Wires and Tapes.
American Electrical Works.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cutter, Geo.
Enterprise Electric Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Moore, Alfred F.
National India Rubber Co.
Phillips Insulated Wire Co.
Sperry Elec. Mining Machine Co.
Washburn & Moen Mfg. Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Hughes Bros. Mfg. Co.
Knapp Electrical Works.
Loud, H. M. & Sons Lumber Co.
Railway Equipment Co.

Cut-Outs and Switches.
Ansonia Electric Co., The.
Bryant Electric Co.
Central Electric Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Electric Engineering & Supply Co.
Emerson Electric Mfg. Co.
Electric Selector & Signal Co.
Enterprise Electric Co.
Great Western Mfg. Co.
Hart & Hegeman Mfg. Co., The.
Knapp Electrical Works.
Perkins Elec. Switch Mfg. Co.
Redding Electric Co.
Russell & Officer.
Sawyer-Man Electric Co.
Sechrist, A.
Utica Elec. Mfg. & Supply Co.

Dynamos.
Brush Electric Co.
C. & C. Electric Motor Co.
Commercial Electric Co.
Duplex Electric Co., Ltd.
Eddy Electric Mfg. Co.
Electrical Eng. & Supply Co., The.
General Electric Co.
Great Western Mfg. Co.
Gregory, C. E. Co.
Heisler Electric Co.
National Electric Manufacturing Co.
Nowotny Electric Co.
Riker Electric Motor Co.
Rose Electric Light Supply Co.
Siemens & Halske Electric Co.
Standard Electric Co.
Waddell-Entz Company.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Heating.
Ansonia Electric Co., The.
Railway Equipment Co.
Taylor, Goodhue & Ames.

Electric Lava Gas Tips.
Smith, A. T.

Electric Railways.
Chicago & St. Louis Elec. R. R. Co.
General Electric Co.
Siemens & Halske Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical and Mechanical Engineers.
Comstock, Louis K.
Hatheway, E. M.
Osborne Steam Engineering Co.
Roberts, E. P. & Co.
Wilson & Jackson.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Knapp Electrical Works.
Queen & Company.

Electrical Intelligence.
Comstock, Louis K
Hatheway, E. M.
Roberts, E. P. & Co.
Wilson & Jackson.

Electrical Specialties.
Columbia Mfg. & Supply Co.
Cutter, Geo.
Holtzer-Cabot Electric Co.
Utica Elec. Mfg. & Supply Co.

Electric Sun Torches.
Clayton & Lambert Mfg. Co.

Electroliers and Combination Fixtures.
Ansonia Electric Co., The.
Baggot, E.
Edwards, W. S. Mfg. Co.
Knapp Electrical Works.

Electro-Plating Machines.
Brush Electric Co.
General Electric Co.

Engines, Gas.
Otto Gas Engine Works.

Fan Outfits.
Diehl & Company.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Engines, Steam.
American Engine Co.
Ball & Wood Co., The.
Freeman Sons Mfg. Co., The S
Lake Erie Engineering Works.
Lane & Bodley Co., The.
Morse & Co., A. M.
N. Y. Safety Steam Power Co.
Pearson & Co., W. B.
Racine Hardware Mfg. Co.
Sioux City Engine Works.
Taylor Engine Co.
Westinghouse, Church, Kerr & Co.
Weston Engine Co.

Fire Alarms.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Fuel Economizers.
Fuel Economizer Co.

Fuse Wire.
Ansonia Electric Co., The.
Knapp Electrical Works.
Shawmut Fuse Wire Co.
Sperry Elec. Mining Machine Co.

Gas Lighting, Electric.
Boston Electric Co.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.

General Electrical Supplies.
Angier & Kennard.
Ansonia Electric Co., The.
Bryant Electric Co.
Central Electric Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Electric Eng. & Supply Co.
Electrical Eng. & Supply Co., The.
Emerson Electric Mfg. Co.
Enterprise Electric Co.
General Electric Co.
Great Western Mfg. Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Palmer Bros.
Partrick & Carter Co.
Penn. Electric Engineering Co.
Queen & Co.
Redding Electric Co.
Russell & Officer.
Sawyer-Man Electric Co
Sioux City Elec. Supply Co.
Taylor, Goodhue & Ames.
Utica Elec. Mfg. & Supply Co.
Waterhouse, Gamble & Co.

Globes and Electrical Glassware.
Angier & Kennard.
Brookfield, Wm.

Graphite Specialties.
Dixon Crucible Co., Jos.

Hard Rubber Goods.
Butler Hard Rubber Co.
Delaware Hard Fibre Co.

Insulators and Insulating Materials.
Ansonia Electric Co., The.
Brookfield, Wm.
Bryant Electric Co.
Butler Hard Rubber Co.
Electric Engineering & Supply Co.
Empire China Works.
Enterprise Electric Co.
General Electric Co.
Hart & Hegeman Mfg. Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Knapp Electrical Works.
Mass. Chemical Co.
Moore, Alfred F.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Standard Paint Co.
Utica Elec. Mfg. & Supply Co.
Vulcanized Fibre Co.

Insulated Wires and Cables. Magnet Wire.
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Ansonia Electric Co., The.
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Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
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Standard Underground Cable Co.
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Western Electric Co.

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Sawyer-Man Electric Co.
Steuben Lamp Works.

Lathes.
Bridgeport Machine Tool Works.
Shepard, H. L.

Lightning Arresters.
Knapp Electrical Works.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Bridgeport Machine Tool Works.

Medical Batteries.
Partrick & Carter Co.

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Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

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Becker Mfg. Co., John.

Mining Apparatus, Electric
General Electric Co.
Great Western Mfg. Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

Motors.
Brush Electric Co.
C. & C. Electric Motor Co.
Commercial Electric Co.
Crocker-Wheeler Electric Co.
Eddy Electric Mfg. Co.
Electrical Eng. & Supply Co., The
Emerson Electric Mfg. Co.
Ford-Washburn Storelectro Co.
Fort Wayne Electric Co.
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Porter-Leavitt Electric Motor Co.
Riker Electric Motor Co.
Rockford Electric Mfg. Co.
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Becker Mfg. Co., John.

Oil Filters.
Acme Filter Co.

Paints.
Standard Paint Co.

Patents.
Paine & Ladd.
Rosenbaum, Wm. A.

Phosphor Bronze.
Phosphor Bronze Smelting Co., Ltd

Pins and Brackets.
Central Electric Co.
Hughes Bros. Mfg. Co.
Loud, H. M. & Sons Lumber Co.
Railway Equipment Co.

Platinum.
Baker & Co.
Siebert, G.

Poles.
Loud, H. M. & Sons' Lumber Co.
Railway Equipment Co.

Porcelain.
Empire China Works.

Pressure Gauges.
Bristole Mfg. Co.

Publishers, Electrical
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

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Rheostats.
Carpenter Enamel Rheostat Co.

Sal Ammoniac.
Innis & Co.
Klipstein, A.

Separators, Steam.
Hine Eliminator Co.

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Boston Braid Mfg. Co.

Speaking Tubes.
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Partrick & Carter Co.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Cars.
Brill, J. G., Co.

Street Ry. Tower Wagons.
Davis, W. S. & Son.

Supplies, Electric Railway.
Angier & Kennard.
Railway Equipment Co.

Tapes, Insulating.
American Electrical Works.
Ansonia Electric Co., The.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
India Rubber & G. P. Ins. Co.
International Okonite Co., The.
Knapp Electrical Works.
New York Insulated Wire Co.
Standard Paint Co.

Telegraph Apparatus.
Central Electric Co.
Electric Selector & Signal Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Telephone Mouthpieces.
Marcus, W. N.

Test Instruments.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Company.
Western Electric Co.

Transformers.
Diamond Electric Mfg. Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Taylor, Goodhue & Ames.
Westinghouse Electric & Mfg. Co.

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Pelton Water Wheel Co.
Stilwell & Bierce Mfg. Co.

Universities
Institute of Technology.

Varnishes.
Mass. Chemical Co.
Standard Paint Co.

Water Wheels.
Pelton Water Wheel Co.

Wire, Bare.
Ansonia Electric Co., The.
Bishop Gutta Perdha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Holmes, Booth & Haydens.
Knapp Electrical Works.
National India Rubber Co.
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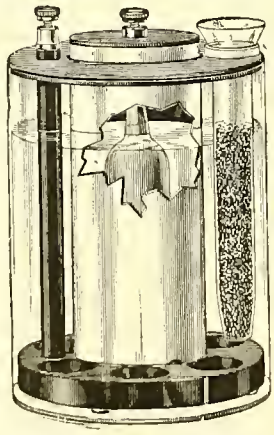

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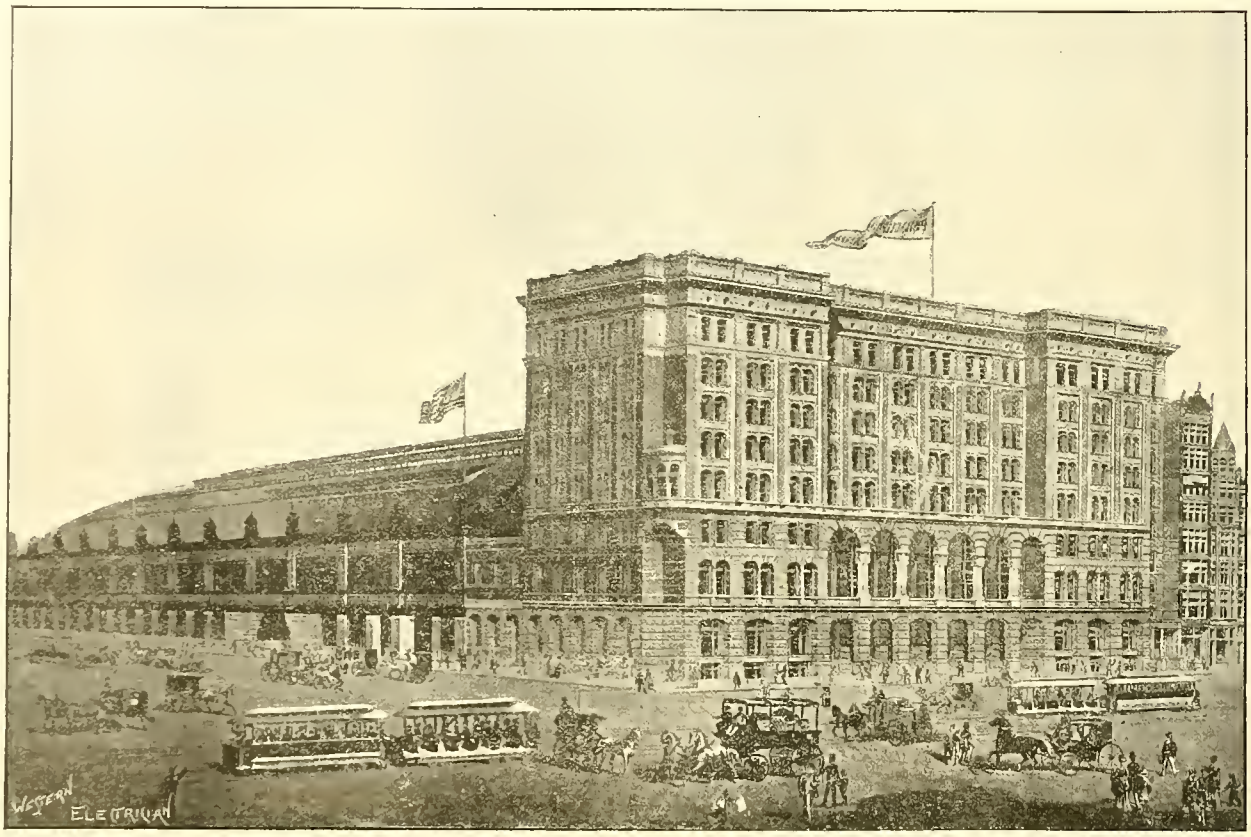

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This installation consists of 300 Western Electric Arc Lights, 10 Western Electric Arc Dynamos and the entire construction work.

Ward Lamp

There are on the market a number of different types of arc lamps for constant potential circuits. If you wish something experimental, try any other lamp except ours. If you want a lamp to use, to give a good light and stand hard knocks, BUY THE "WARD."

We carry in stock, at all times, a full line of single carbon lamps, double carbon lamps, short lamps, ornamental lamps, twin lamps, photo-engraving lamps, search lamps and all styles of focusing lamps.

We do our experimenting in our own shops, and not on the plants of our customers. It is no experiment to buy our standard lamps. They have been in use for years. They are STANDARD. We don't have to bring out a different type of lamp every month, and take back in exchange the lamps of the preceding type. Neither has any other make of arc lamp superseded the "WARD."

We guarantee satisfaction. Remember that the central stations using the "WARD" lamp in large quantities are the best paying in the country.

Write us, and see what we can do for you.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

Unity Building, CHICAGO.

Established 1881.

Telephone Building, NEW YORK.

California Electrical Works,
SAN FRANCISCO.
CALIFORNIA AGENTS FOR

H. H. HUMPHREY,
ST. LOUIS, MO.
Agent for

If the San Francisco *Call* speaks the truth, the introduction of electrical roads into New Orleans is likely to be followed by a plague of monster cats. It says that since the trolley was established in that city the cats have grown so big and so numerous as to constitute a nuisance and a menace. It is said that daily, about the time that the cars stop running for the night, cats from everywhere begin to congregate along the tracks for electric food or baths, one cannot tell which. Carefully selecting a suitable spot on the rail, the cat in search of refreshment will lick the rail, and then lie down upon it for a few minutes Pretty soon he will roll over on the rail, and will stand with all four feet upon it, and with wild eyes, arched back and disteoded tail, will yowl and dance, and amuse himself for an hour at a time. An expert electrician, who was consulted on the subject, said that he could not imagine what effects the cats could get out of the rail; but whatever it may be, the cats of the city are said to be attaining an enormous size, unheard of before, and to keep themselves in woodrous good condition.

We account for the above phenomena by assuming that ***Kerite Wire*** is used by the roads mentioned, for ***Kerite*** has a way of fattening the pocketbook of its users, and they in turn grow fat from good living. Messrs. Cushing & Morse, Gen'l Western Agents for Day's Kerite Wires and Cables, 225 Dearborn St., Chicago, are good exemplifications of the fattening qualities of ***Kerite Wire.*** One or the other of them may be seen at Convention Headquarters daily, or at their office, where they are continually securing good fat orders.

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We would respectfully invite all delegates and others interested to call at the Railway Exchange Room, Southern Hotel, during the convention, to inspect our new SLOW SPEED MOTOR which can be seen in full operation.

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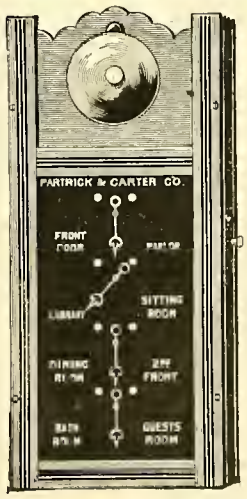

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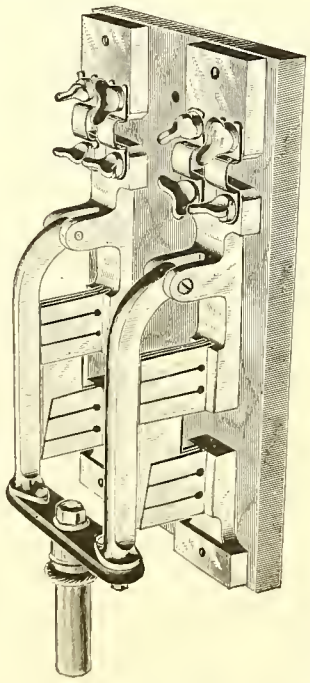

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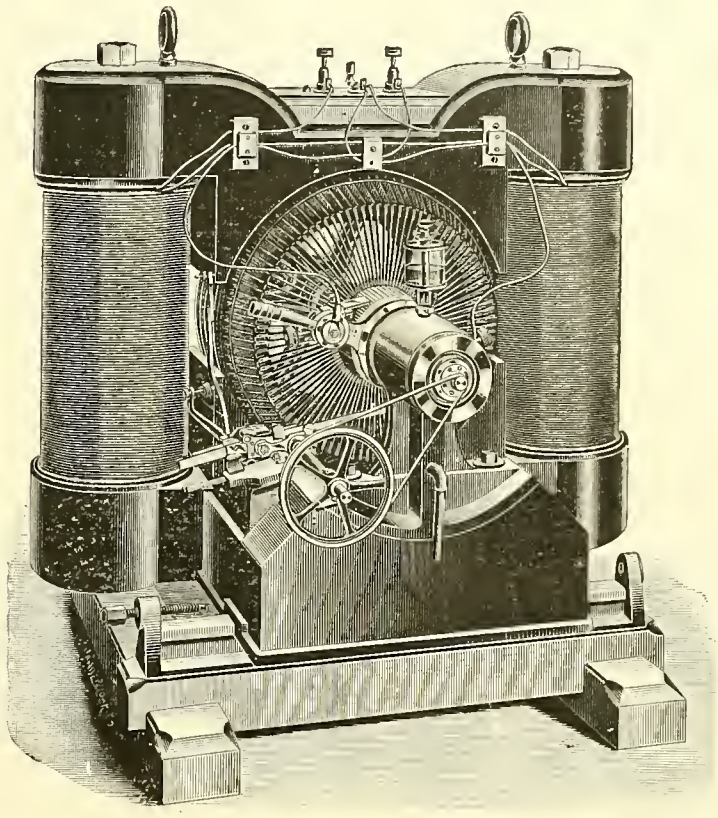

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For lighting stores, foundries, factories or the streets of a city, this system has no equal.

Our contract does not obligate the purchaser to buy apparatus or supplies exclusively of us for a term of years, but courts open competition and encourages fair tests for merit between any and all existing arc lighting systems and the STANDARD.

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FOR CENTRAL STATION AND ENGINEERING PRACTICE.

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MESSRS. JAS. W. QUEEN & CO., Philadelphia.
In answer to your inquiry under date of Nov. 21st would say that testing set T305, marked 487, has given us most satisfactory results, and we feel thoroughly satisfied with it in detail.
It has won our confidence to the extent that we accept it as a standard, not only as a portable instrument, but to a greater share of our laboratory work and electrical measurements.
It is correct to within a small degree, easily manipulated, and results quickly obtainable, and can say that we do not know of one single point left to be desired in this instrument, for an instrument of this nature. Very respectfully yours,
NATIONAL ELECTRIC MFG. CO.,
C. E. Woods, Inspecting Eng.

WINDSOR, CONN., Jan. 16, 1893.
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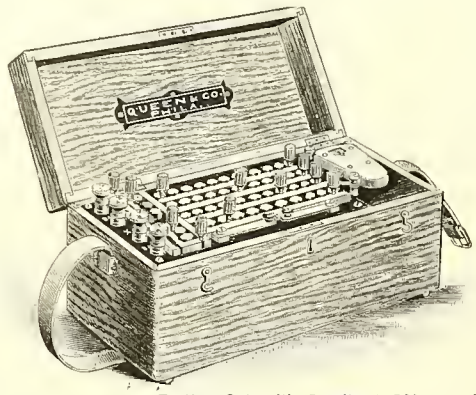
GENTLEMEN:—In reply to yours of the 14th we are pleased to state that the portable testing set purchased from you some time since is giving us good satisfaction. As the wire and insulation resistance of every machine we build is measured we find it essential to have a bridge that can be operated with rapidity and certainty. So far your testing set has met every requirement. Yours truly,
THE EDDY ELECTRIC MFG. CO.
H. S. Rogers, Electrical Eng.



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Range .001 to 11,110,000 ohms.
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Have used it on all kinds of work, for both high and low measurements, and think it is about as complete an instrument of the kind as I have ever used. Yours truly,
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R. S. Kelsch, Supt.

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GENTLEMEN:—Regarding the Portable Testing Apparatus purchased from you some time since, would say that it has given us entire satisfaction in all work in which we have used it up to this time. Yours respectfully,
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C. E. Ball, Gen'l Manager.

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JAS. W. QUEEN & CO.,
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At the present time we are making a special push of our **IMPROVED PORTABLE TESTING SETS,** which appeal very strongly to central station managers, electrical engineers, telegraph and telephone linemen, etc., as being absolutely the only portable apparatus for measuring resistance that can be used under every conceivable condition of practical work. Magnetic fields and mechanical vibrations produce no effect whatever, and equally accurate results are secured in a manhole or near heavy machinery, as in a college laboratory. Our "T 305" set is the only one supplied with a galvanometer sufficiently sensitive for universal use, and that at the same time meets the above exacting conditions. The coils are wound with platinoid wire and guaranteed accurate to one-fifth of one per cent., as stated on a certificate furnished with each box. We confidently recommend the above as an instrument that will pay for itself in satisfaction alone, in a short time. Place an order with us now, and ask for descriptive circular No. 285.

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IMPORTANT DECISION IN A PATENT SUIT.

Crocker-Wheeler Motor Company Held as Infringers.

On February 7, 1893, the United States Circuit Court for the Southern District of New York, through his Honor Judge Wheeler, rendered a decision upholding the validity of U. S. Letters Patent No. 393,266, dated November 20, 1888, granted to ANDREW L. RIKER, for improvement in dynamo-electric machines or electric motors. The CROCKER-WHEELER MOTOR COMPANY were declared by the court to be INFRINGERS.

A decree has been entered requiring said company to account for profits and damages of past infringement and enjoining them from the further manufacture of infringing armature.

The TRADE and the PUBLIC generally are WARNED against infringement.

All persons who deal in Motors containing Armatures which infringe this patent, as well as all users of such machines, are liable to prosecution as infringers, and to suit for injunction and damages.

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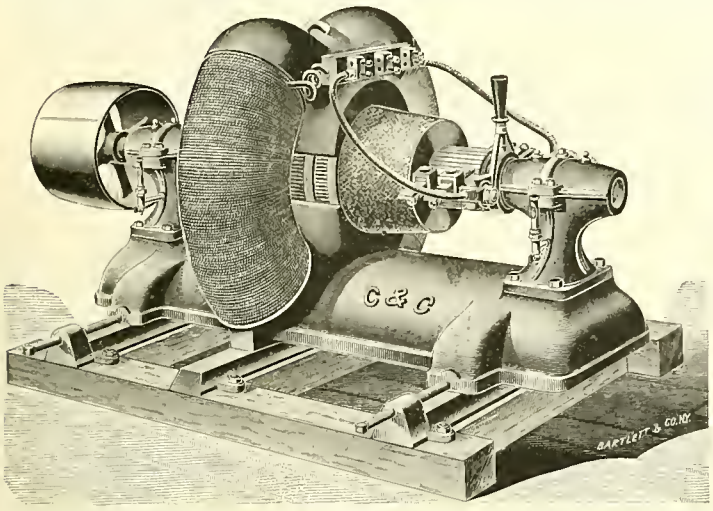

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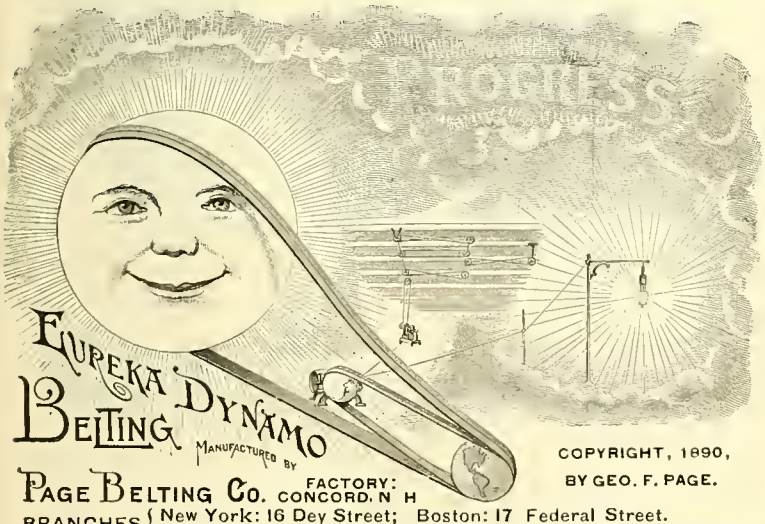

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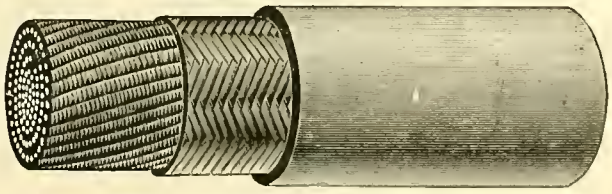

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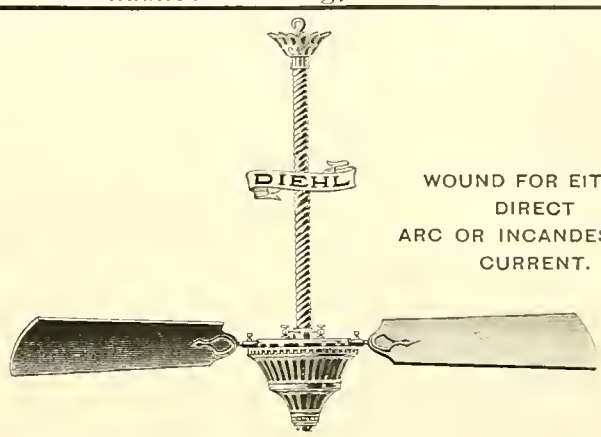

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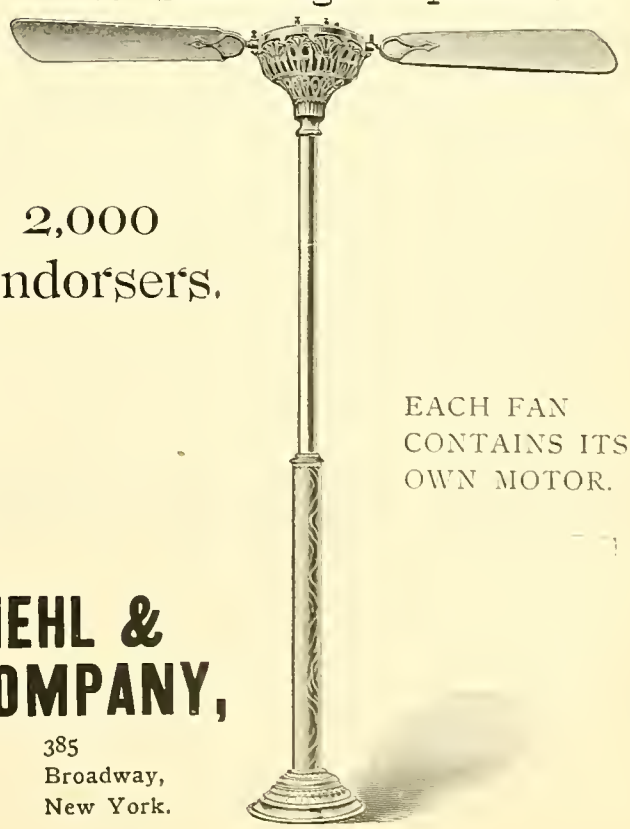

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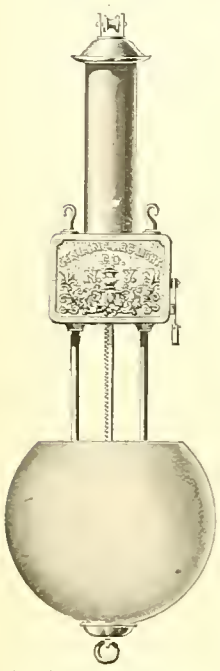

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These qualities of reliability, ease of trimming, and agreeable, steady light have enabled the

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to install these Lamps in many instances in place of electroliers, and have resulted in the production of an extensive and handsome line of

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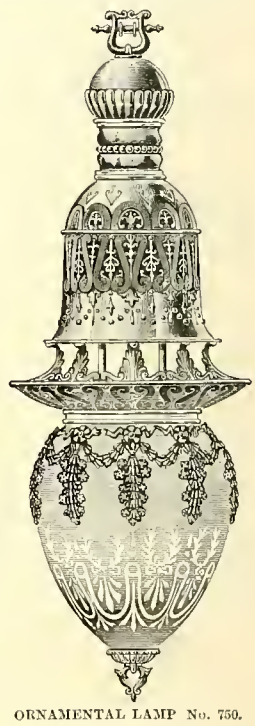

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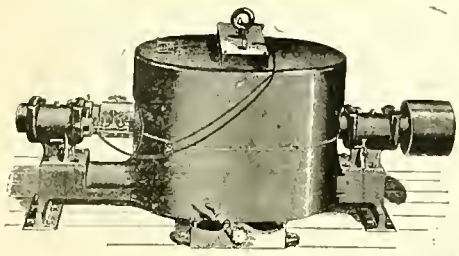

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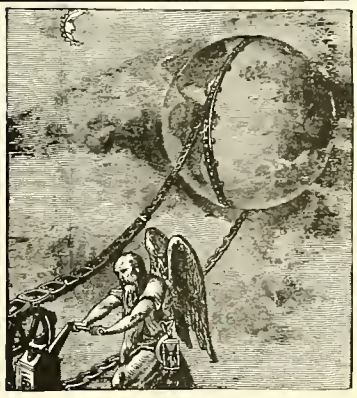

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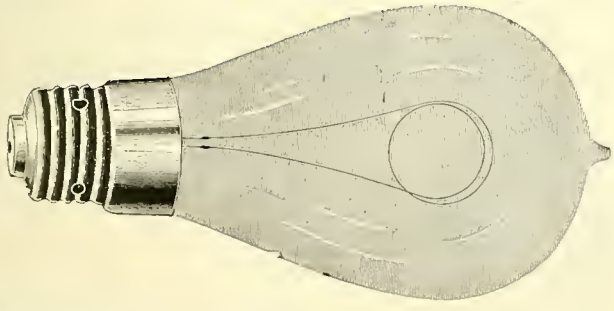

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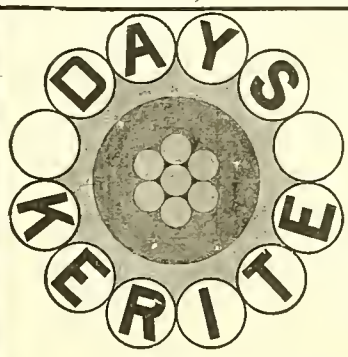

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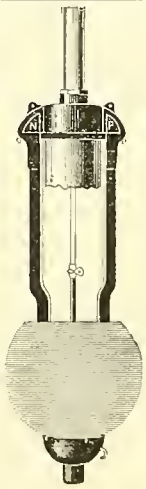

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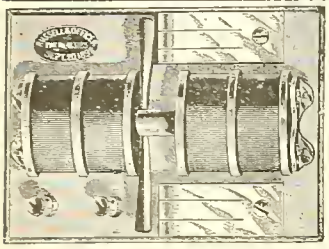

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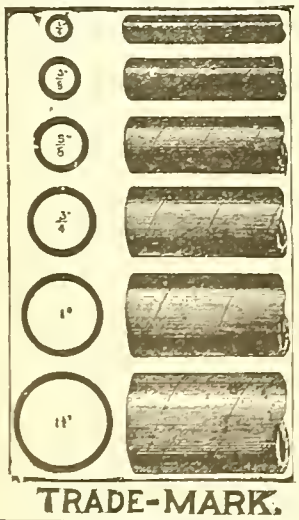

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SLOW SPEED, MULTIPOLAR DYNAMO.

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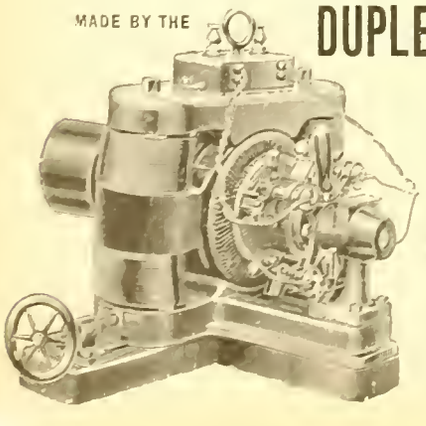

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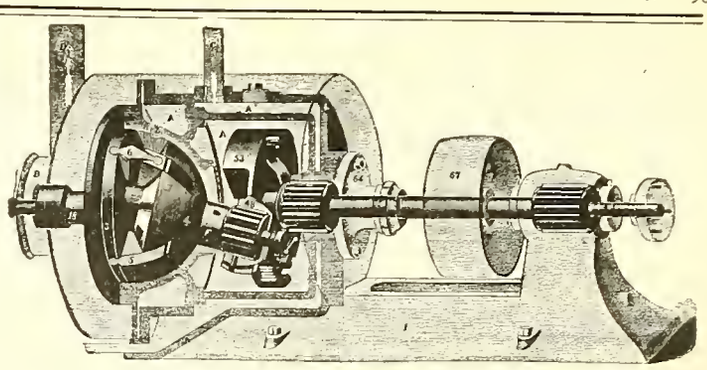

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It has no competitors.
Runs easily and smoothly
1000 REVOLUTIONS and more, in small sizes, and proportionally fast in larger sizes.

Unsurpassed for Economy

and close automatic government.

DYNAMOS,
CIRCULAR SAWS,
FANS, BLOWERS,
THRESHING MACHINES,

etc., run by **direct coupling** without belts.

It's the acme of simplicity. There's great saving in foundations, little or none being required, also in oil consumed and attention required.

For high speed machinery it saves many shafts, counter-shafts, hangers, pulleys, belts, and great loss of power incidental to their use. Speed readily reduced for slow running machinery.

This Engine is

NOT A "ROTARY,"

as its piston does not revolve: runs standing on either end, or placed horizontally, equally well; is *wholly* self-contained. Takes up but little room.

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is very light, and has simple, effective reversing mechanism. Especially well adapted for high speed Launches and Yachts. Its position in bottom of boat is most favorable for ballast.

Engines of 2 to 200 Horse Power can be furnished on short notice.

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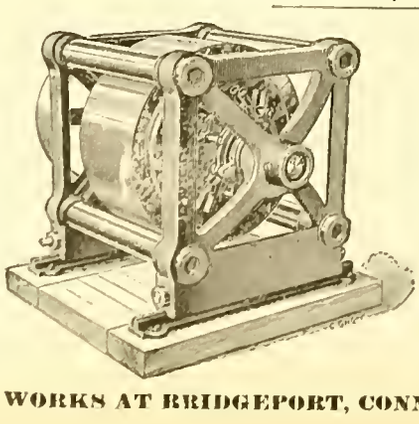

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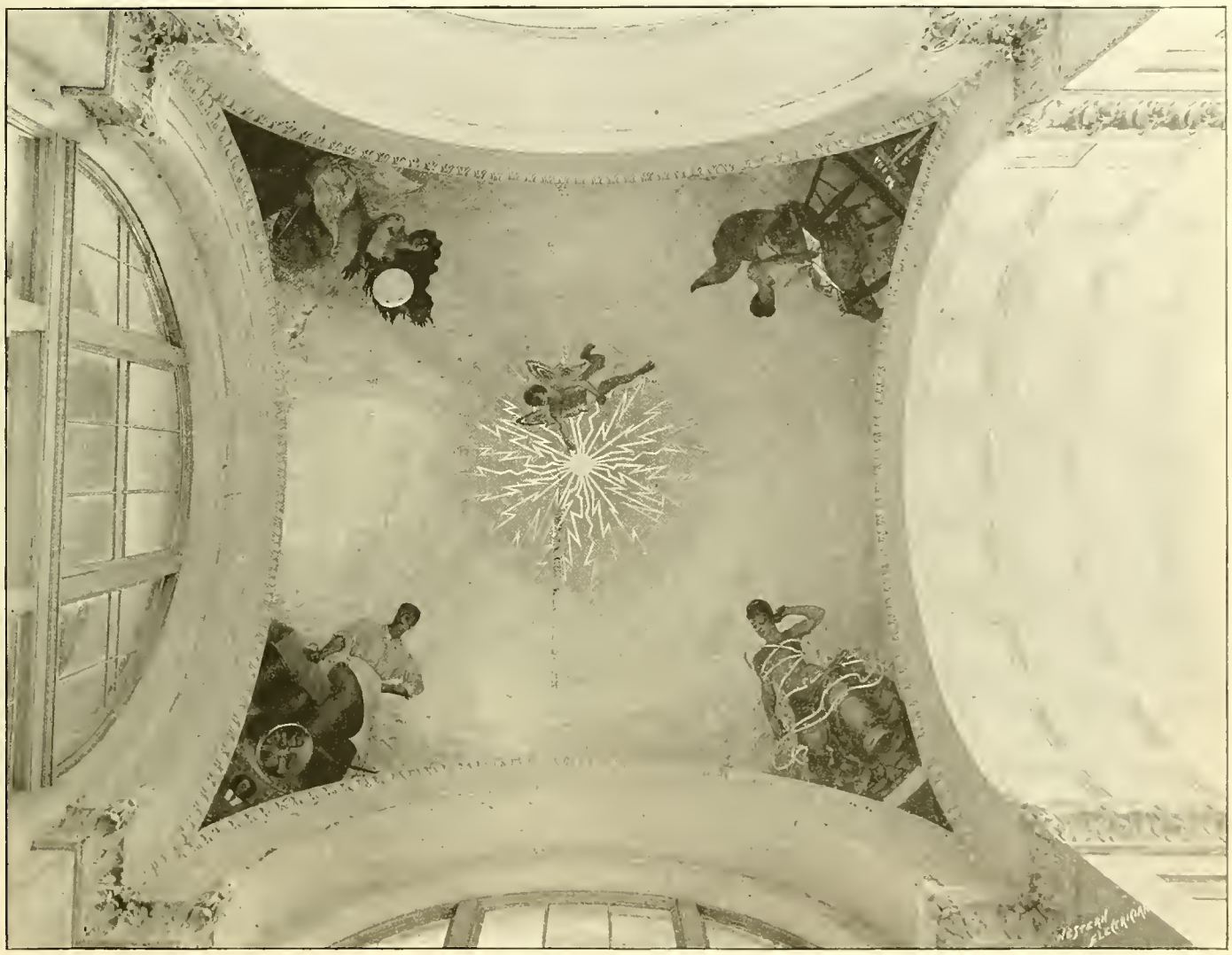
Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, MARCH 4, 1893. No. 9

Electricity at the World's Fair.

Among the contributions made by painters and sculptors to the decorations of the World's Fair are several designs and figures representing electricity. One of the best of these is shown in the illustration on this page. It was designed and painted by J. Carroll Beckwith, of New York, formerly of Chicago, and can be found on the ceiling of the western entrance of the central pavilion at the northern end of the manufactures building. The ground work is of gold and the figures are appropriately colored. The center figure represents the Genius of Electricity and is in electrical connection—from an artistic point of view—with the four exponents of the art in the corners. These figures, as can be readily seen, typify the operation of the arc and incandescent lighting systems, telegraphy and telephony. The whole composition is harmonious and effective and will attract much attention.



ELECTRICITY AT THE WORLD'S FAIR.

The World's Fair force of the Westinghouse company has removed to its new building south of the western end of machinery hall. This building is well adapted to the use for which it was designed. It was illustrated and described in the WESTERN ELECTRICIAN some time ago. The New York Insulated Wire company is preparing offices over its warehouse in the southwestern portion of the grounds.

The electricial engineer of the German commission has submitted his final drawings to Chief Barrett, also a list of German individual exhibitors, and the German workmen are now at work. Although 23,000 feet of space has been awarded to the German commission, exhibits from several large firms not provided for have been recently offered and Prof. Barrett is hunting for more space to give Germany. A letter from one German firm has just been received saying that its apparatus has been shipped and suggesting that the department will undoubtedly be able to find space for it. This particular firm has not been provided for, but as the exhibit is new and interesting, space will be found for it, "even if we have to close over a light-well or force out an aisle or two."

M. Mascart, electrician for the French commission, came over with the first consignment of French exhibits and is now in New York waiting for the next steamer load, when he will come on to Chicago to begin work. In the meantime he has forwarded all his drawings to the department through Deputy Commissioner Bruwaert and they have been approved. The French commission has 23,000 feet of space in the electricity building, and M. Mascart writes from New York that he will have to rely on the chief of the department for a little more space in which to install a few especially attractive exhibits for which he has not been able to make provision. The French section will be highly artistic to the eye as well as interesting to both professional electricians and the public.

About two hundred wiremen employed by the New York Insulated Wire company and the Exposition company on World's Fair work struck on Thursday of last week. The men have been getting 31 cents an hour and they demand 37½ cents and a day of eight hours. The demand was refused and the men went out. The employers do not anticipate much difficulty in getting men to take the places of the strikers at the prevailing rate of wages. The men say that the National Brotherhood of Electrical Workers, to which they belong, is affiliated with the Building Trades Council and that all the members of the latter body may eventually be drawn into the strike.

Chicago Electric Club.

At a meeting of the Chicago Electric club on Monday evening, February 20th, C. G. Armstrong read a paper on "Electric Installations and Some Radical Changes in General Systems of Wiring." Stereopticon views were presented to illustrate the paper.

It is announced that the club has reorganized its restaurant service, and that several improvements have been made. Every effort is being made to improve the accommodations and add attractive features to the organization.

Electrical Features of St. Louis.

Western people in general, and Chicagoans in particular, are in the habit of speaking disparagingly of the city whose electrical interests are now doing so much to make a success of this year's convention of the National Electric Light association. That these criticisms are, as a rule, not unkindly meant and are oftentimes made in joke is well understood. But for the benefit of those who will not be in St. Louis at the time of the convention it should be stated that it would be hard to find a body of men more alive than the St. Louis electrical fraternity. At least this is the impression of visitors who have witnessed the hearty and energetic manner in which the electrical people in the hospitable old city are preparing for the reception of their guests.

Delegates and visitors to the convention of the National Electric Light association will find much of an electrical nature to interest them in St. Louis and this is due to a large extent to the fact that the municipality has been very liberal and has exhibited great forethought in its dealings with electrical enterprises. Legislation in St. Louis has always been in the direction of fostering and developing electrical interests. This policy on the part of the city, coupled with the fact that St. Louis offered a wide field for electrical work, has led to an almost unexampled development along electrical lines.

About ten years ago the city fathers decided that all electric light wires must be placed underground. But they found very soon afterward, however, that such a stand as this would result in St. Louis doing without electric light. It was therefore decided to permit overhead work under reasonable regulations. The immediate result was the building of two large central arc light stations with a combined capacity of nearly 1,600 lights. Four years ago the same question of putting the wires underground was brought up in connection with the question of the introduction of electric railways, and after a long and thorough study of the problem, it was decided that it would be far better to have rapid transit by the electric railways and overhead construction, than to retain indefinitely the primitive horse cars. The result, as seen to-day, is that St. Louis boasts some of the most extensive and modern electric railway plants in the world. The service extends into the very heart of the city, and the overhead construction has been found to be no serious objection, nor has it proved dangerous, for in fact, accidents from the electric current, although not altogether unknown, have been so rare as to offer no serious argument against the overhead conductors.

St. Louis is ambitious in electrical ventures. Its citizens even assert that "it is the electrical city of the world," and there are few that dispute the claim to pre-eminence in this direction. For in whatever field of electric work an investigation is made, whether that of light, the railway, power, the telegraph or the telephone, plants may be found which may be taken for models.

In the direction also of electrical manufacturing, St. Louis is showing itself to be progressive. There are now in the city in active operation and doing good business a number of electrical and allied industries, and, though St. Louis cannot yet claim for itself the distinction of being referred to as an electric manufacturing center, it may at least be said that its manufacturers can furnish a considerable proportion of the electrical fixtures and appliances required.

The city is particularly proud of its lighting, railway and stationary power stations, and while the power plants will not be of paramount interest to electric lighting men they will at least be worth their careful study.

Visitors interested in things electrical should remember that it has been claimed for St. Louis that it has more miles of electric railway than any city in the world, Boston not excepted; that it has a longer electric road than any city in the world; that electricity for railway purposes is transmitted to greater distances in St. Louis than in any city in the world; that St. Louis has the largest arc lighting station in the world, that it has the largest alternating incandescent station in the world; that it has the most comprehensive telephone system, and the best service of any city in America—probably in the world; that St. Louis has an electric street railway doing a thriving business which for part of its route replaced a cable line and for the remainder replaced a suburban steam railway.

And St. Louis has its inventors, too, of world-wide fame. The name of one of them is already familiar to every electrical man through his work in series incandescent lighting. Another patented a fundamental idea of electric street railway mechanism, and is now before the courts for the hearing of his claims. So, taken all in all, many delegates to the convention will doubtless be surprised and perhaps astonished when they come to a full realization of the extent to which things electrical have been developed within the confines of the modest old city.

First in the minds of the visitors, of course, will be the electric lighting central stations, and a brief description of each of these, together with one view taken in each plant, is presented herewith.

The two lighting stations that will prove most interesting are the plant of the Municipal Electric Light & Power company, corner Nineteenth and Gratiot streets, and that of the Missouri Electric Light & Power company, corner of Twentieth street and Lucas avenue. Views of the dynamo room in each of these stations are shown on page 99.

The Municipal plant was constructed under the most serious drawbacks, which might have made ordinary men despair of success. It was built in the short space of a few months, and for a varied service, which for number of lights and area covered was unprecedented. To-day this station stands as one of the largest arc lighting stations in the world, and it is growing now as fast as in any period of its history.

The plant of the Missouri Electric Light & Power company is devoted wholly to incandescent service by the

MAP OF ST. LOUIS, SHOWING POINTS OF INTEREST.

1. Union Depot.
2. Southern Hotel.
3. St. James Hotel.
4. Laclede & Hurst's Hotel.
5. Lindell Hotel.
6. Electric Club.
7. Telephone Building.
8. Exposition Building.
9. Missouri Electric Light & Power Company.
10. Municipal Company.
11. Laclede Gas Company, Electric Department.
12. St. Louis Electric Light & Power Company.

Westinghouse alternating system. It is one of the largest incandescent lighting stations in the country. The business is growing fast, and additional apparatus of the most modern pattern will be added this summer.

MUNICIPAL ELECTRIC LIGHT & POWER COMPANY.

This company is under contract to supply the city arc lighting for a period of ten years, ending April 1, 1900. The station, which is at Nineteenth and Gratiot streets, is not only the largest arc station in the world, but it does an extensive business in incandescent lighting and the distribution of power. The station is designed for an ultimate capacity of 7,000 arc lights. At present 3,600 of these lights are being operated, 2,100 of them on the city contract, and 1,500 to private consumers. The dynamos are of the Wood pattern, manufactured by the Fort Wayne Electric company. There are seventy-nine of them; most of them having a capacity of 60 arc lights, but some of them being capable of furnishing current for 80. There are at present seventy different circuits, averaging fourteen miles each, making a total mileage of arc circuits of nearly 1,000. There are a number of very long circuits, one being about twenty-three miles in length. The most distant point reached from this station is at the extreme city limits, seven miles away. The building is a brick structure, four stories in height. On the first floor are the engines; on the second the countershafting, friction clutches, pulleys, etc.; on the third the dynamos and switch-board, and on the fourth the store room, repair shop, etc. The engines, seven in number, are of the Corliss type, six of them being 600 horse power each, and one 700. They are all of the Hamilton-Corliss pattern. Belt transmission is employed throughout. There are nineteen vertical boilers of the Roban porcupine pattern; each is rated at 300 horse power capacity. These boilers are arranged in a special boiler house, just west of the main building. This station was equipped in a remarkably short time. It was necessary to cover the entire city with circuits, most of which required new pole lines. The entire city north of Osage street, with the exception of the alleys, is lighted from this station. The company employs 300 people, of whom 50 are skilled workmen. Coal is unloaded directly from cars on a side track, and there is a storage capacity for 200 tons in order to provide against the possibility of a shut-down due to a failure in the coal supply.

This company entered the incandescent business in 1891 and now supplies about 25,000 lights to private consumers. There are now in the station seven 3,000 light alternators of the Slattery pattern, made by the Fort Wayne Electric company. The system of distribution is the same as that employed by the Missouri company. The company still operates the Heisler station on Third and Gratiot streets, from which 3,000 lights are supplied, mostly for commercial purposes, the system being the Heisler series. An interesting feature of the Municipal's incandescent system is that current is supplied to the Suburban Electric company operating in Webster Groves, St. Louis county, ten miles distant. At present 500 lights are being operated there, but it is expected that the number will be increased to 3,000 next summer, when the Suburban company fully covers its territory. The plans for this service include step-up and step down transformers during the hours of heavy loading, when the patronage shall have increased beyond the capacity of the present mains, at 1,000 volts pressure. This will be the first example of this branch of electrical engineering in the city.

JAMES I. AYER.

The man to whom more than to any other person the success of the Municipal company's plant may be attributed is James I. Ayer, under whose personal supervision the station was built and the business conducted ever since. Mr. Ayer needs no introduction to the electric light men of this country, especially to the members of the National Electric Light association. They have testified their appreciation of his ability and rewarded the efforts he has made for the advancement of their interests by electing him president of the organization. Mr. Ayer was born in 1854 at Medford, Mass. After finishing his academic education he took an engineering course at Elizabeth, N. J. Mr. Ayer first became interested in electrical matters in 1884, when he entered the Jenney Electric company of Indianapolis. He assumed general charge of the company's affairs, and his practical business knowledge, together with his experience in mechanical work, proved valuable to the company. Under his direction the stations of the Jenney company were overhauled and remodeled and many changes were made in the arrangement and equipment of the principal plants.

The crowning feature of Mr. Ayer's work was the building and equipment of the Municipal company's plant at St. Louis. When Mr. Ayer severed his connections with the Jenney company he took the management of the Municipal company at St. Louis. The station is looked upon as a model plant.

MISSOURI ELECTRIC LIGHT & POWER COMPANY.

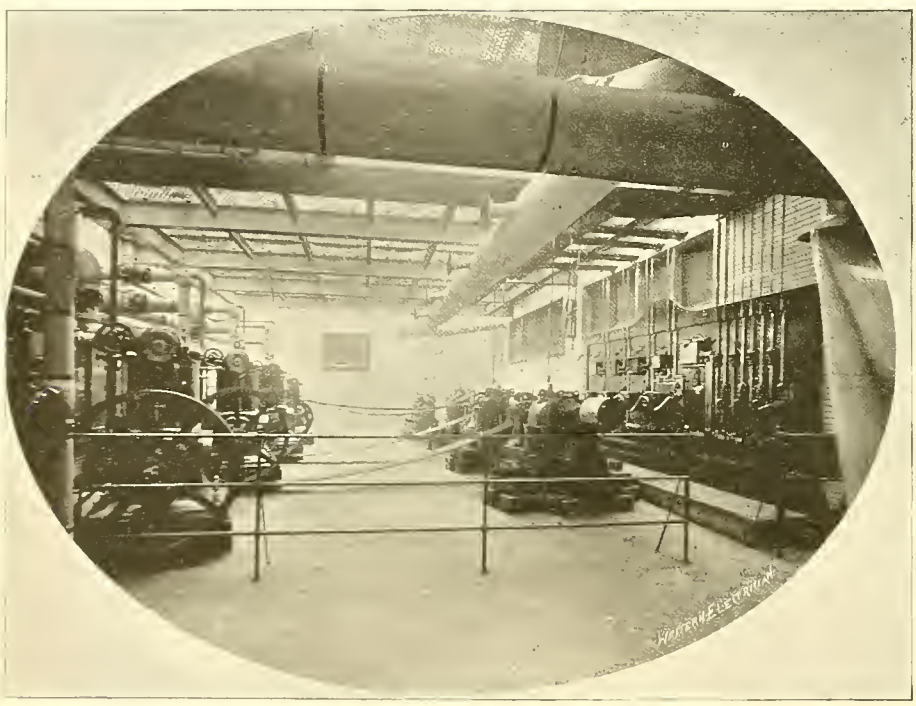
The Missouri Electric Light & Power company was organized in January, 1889, and soon afterward contracted with the Westinghouse Electric company for incandescent lighting apparatus. The plant was designed and erected under the supervision of Herbert A. Wagner, at that time an engineer in the employ of the Westinghouse company. His extended experience in the shops of this company, and in erecting numerous plants in various parts of the country,

CENTRAL STATION ELECTRIC LIGHT PLANTS IN ST. LOUIS.

Missouri Electric Light & Power Co.
Herbert A. Wagner, General Superintendent.
Laclede Gas & Light Co.—Electrical Department.
Fred. G. Schlosser, General Superintendent.

Municipal Electric Light & Power Co.
James I. Ayer, General Manager.
St. Louis Electric Light & Power Co.
D. W. Guernsey, President.

in addition to his thorough study of mechanical and electrical engineering at the Stevens Institute of Technology, made him eminently competent to undertake the work. After completing the plant he severed his connection with the Westinghouse company to accept the position of general superintendent of the Missouri company. All the machinery in use, through proper design and application and careful attention, has given almost unexampled service, and the high class of workmanship shown on the outside lines has caused much admiring comment. The plant occupies a substantial fire-proof building 120 feet by 155 feet at the corner of Twentieth and Locust streets. The boiler room contains fourteen three hundred horse power Babcock & Wilcox boilers, connected by underground flues to two steel stacks 8 feet 6 inches in diameter by 130 feet high and 10 feet in diameter by 150 feet high, respectively. Hooker feed water pumps and Berryman feed water heaters are used. Coal storage bins are provided to accommodate about fifteen hundred tons of coal. In the engine and dynamo room are nine 300 horse power Westinghouse compound engines belted direct to nine 3,500 light Westinghouse alternating current generators, and two 600 horse power engines of the same make belted to two 6,000 light generators. The switchboard is one of the most striking features of the plant, being constructed principally of white marble, and so arranged that any circuit may be changed



ELECTRIC LIGHTING PLANT IN THE WAINRIGHT BUILDING, ST. LOUIS.

at will from any generator to any other without extinguishing a light. There are no bare connections on any switch or instrument. This board was constructed in its entirety, excepting the indicating instruments, by the Wagner Electric Manufacturing company of St. Louis. The belting used was made by the Munson and Shultz belting companies. The total number of 16 candle power lamps now connected is eighty-seven thousand, divided between twenty-two hundred customers, about twenty thousand being in residences. With the exception of five thousand city lights, these are all on the meter system. The greatest lineal distance in any one direction from the plant at which light is supplied is about seven miles, and the total mileage of circuits is over five hundred. The officers of the company are: S. M. Dodd, president; J. C. Richardson, vice-president; S. B. Pike, secretary and treasurer; Herbert A. Wagner, general superintendent.

HERBERT A. WAGNER.

Attention has often been called to the fact that the wonderful development of the electrical industry has been accomplished largely by young men. This is not, perhaps, strange when it is remembered that the profession of electrical engineering itself is still very young. Nevertheless, we cannot help being surprised occasionally at the extent and variety of the responsibility in electrical work which we find resting acceptably upon young shoulders. An instance of this is shown in the case of Herbert A. Wagner, now general superintendent of the Missouri Electric Light & Power company, which is one of the largest incandescent station in the world. Mr. Wagner is 26 years of age. He pursued a course of study in mechanical and electrical engineering at the Stevens Institute, where he was granted the degree of M. E in 1887 From his earliest college days he took a great interest in electrical research, and, although there was at that time no special course in electrical engineering, he devoted as much time as possible to the study of electricity. During his last year at the institute, he acted as assistant to the professor of electricity. After leaving college, he entered the shops of the Westinghouse company at Pittsburg, and shortly thereafter began installing central stations for them. In June, 1888, he visited St. Louis with Mr. Pantaleoni, then western traveling agent for the Westinghouse company. These gentlemen immediately took steps looking to the organizing of a central station lighting company in St. Louis to use Westinghouse apparatus. Their labors resulted in the organization in January, 1889, of the Missouri Electric Light & Power company. Mr. Wagner is also at the head of the Wagner Electric Manufacturing company, in connection with which enterprise he has made a special study of alternating current motors. Mr. Wagner is prominent in the St. Louis Electric club, being a member of the board of managers, the house committee and entertainment committee.

LACLEDE GAS LIGHT COMPANY'S ELECTRICAL DEPARTMENT.

The Laclede Gas Light company operates an incandescent plant at the foot of Mound street. The plant furnishes power to the Laclede Power company. The electrical equipment of the Laclede Gas company's station is of the alternating type. The indoor lights are operated on the transformer system, with Brush apparatus, and 2000 volts primary circuits. There are five alternators of 750 light capacity, three of 1200 and one of 3,000. A second 3,000 is now being added. The lights used on the city contract for lighting the alleys are supplied by four Heisler series dynamos, each having a capacity of 450 32 candle power lights.

The city contract covers 1200 32 candle power lamps for alleys and streets, and 500 16 candle power lamps for buildings. In addition to these there are about 6,500 commercial and residence lights connected, mostly north of Washington avenue, to which district its operations are confined. There are six Heisler circuits, with a total mileage of 150. The longest is thirty miles, the most distant point eight miles. There are four Brush circuits aggregating 100 miles, reaching a distance of 8 miles from the station. All this work is calculated for a maximum drop of 3 per cent. In the steam plant there are three 314 horse power Heine safety boilers, built for high pressure. They were tested to 350 pounds, and run regularly at 150. The stack is of iron, 140 feet high and 17 feet diameter. The engines are all condensing; two of them are of the Williams triple expansion type, cylinders 9, 14 and 23 by 18. They are rated at 250 horse power each, speed 240. These engines are coupled to opposite ends of a line shaft, from which friction clutch pulleys and rope transmission deliver the power to the dynamos on the floor above. There are also two Armington & Sims cross-compound engines, 15 and 23 by 15, rated at 350 horse power each; speed 260. These are belted direct to Brush alternators. A cross-compound Buckeye engine is now being added; dimensions 14 by and 2824, speed 160. This engine will be belted direct to the new 3,000 light alternator. There is a single cylinder Buckeye engine of 150 horse power for the light work. There are two condensers, one 700 horse power, of the Wheeler surface pattern, and one 500 horse power of the Deane jet pattern. The additions now being made will carry the plant through the winter, but it is expected that another boiler, engine and condenser will be added next fall for the winter load.

LACLEDE POWER COMPANY.

This company operates from the electrical station of the Laclede Gas company, and receives its power from the steam plant of that company under a five years' contract with the Laclede Gas Light company. The Laclede Power company operates 1,000 horse power of motors, varying in size from 1-8 to 40 horse power. At one point 15,000 feet from the station two motors aggregating 55 horse power are in use. The average size of motors in service is about 7½ horse power. An area of about twelve square miles is covered, the most distant point being four miles from the station. The current is distributed at 500 volts pressure and it is claimed that this is the largest power station in the country, not railway, using this pressure. Within the last two years the size of motors has greatly increased, and it is believed that for any thing less than 75 horse power it is cheaper to rent electrical power than to run a boiler and engine. The Laclede company furnishes power during the entire twenty-four hours. The company operates two 7½ horse power motors, which are driving dynamos for supplying the Postal Telegraph company with current. It may, therefore, be said that the Laclede Power company's current does work across almost the entire continent, from New York to Denver. The following list indicates to some extent the character of service in which the Laclede company's motors are now employed: Two morning daily papers, a number of direct connected electric elevators, sewing machines, printers and publishing houses, machine shops, organs, clothing factories, woodworking establishments, ventilators; besides a wide variety of factories.

Among the youngest men in charge of electric plants in St Louis is Frederick G. Schlosser, general superintendent of the electrical department of the Laclede Gas Light company. Mr. Schlosser is now 24 years of age, and is a graduate of Cornell University, where he took the degree of M. E. in 1889. In the fall of that year he located at St. Louis as electrical engineer for the Laclede Gas Light company, and was with that company from the beginning of its electrical work. In November, 1890, he was given the complete charge of this station. He is a member of the Engineers' club of St. Louis.

ST. LOUIS ELECTRIC LIGHT & POWER COMPANY.

This company's station is located at 211 Lucas avenue. The business was begun in November, 1887, and it is said to have been the first purely electrical power station in this country. The steam plant consists of four boilers capable of doing 200 horse power each; they are of the 4 inch horizontal tubular pattern. There are now four engines of the Russell make. Three of these are rated at 175 horse power each, and of the four valve pattern; the other is a 75 horse power, single valve; the fifth engine is of the Westinghouse make, 125 horse power. A sixth engine of the four-valve Russell pattern is now going in, its rating being 345 horse power; cylinders, 20by 27; speed, 150. Direct belting from engines to dynamos is being employed throughout, some pulleys carrying as many as three belts.

There are six generators, all of the Edison pattern, two of 80 kilowatt, and four of 32½ kilowatt capacity. A National generator of 120 kilowatts is now being put in. The system of distribut on is 250 volts station pressure and 220 at the motors throughout the city. The entire business of this company is confined within a radius of one and a half miles from the station. About 140 factories are supplied with power, the largest single motor being 25 horse power, although several establishments use more than this divided among several motors. About two years ago this company entered the field for arc lighting, and has now in operation two 50 light Excelsior dynamos, and three 60 light Western electric dynamos, and are now adding two 60 light Western. All of these lights are of 2,000 nominal candle power. The company is now furnishing about 270 arc lights, 200 of which burn all day. Additional boiler capacity will be put in, probably of the water tube pattern. Plans have also been perfected to make a considerable change in the station next summer. A second story will be added to the building, the small Westinghouse engine

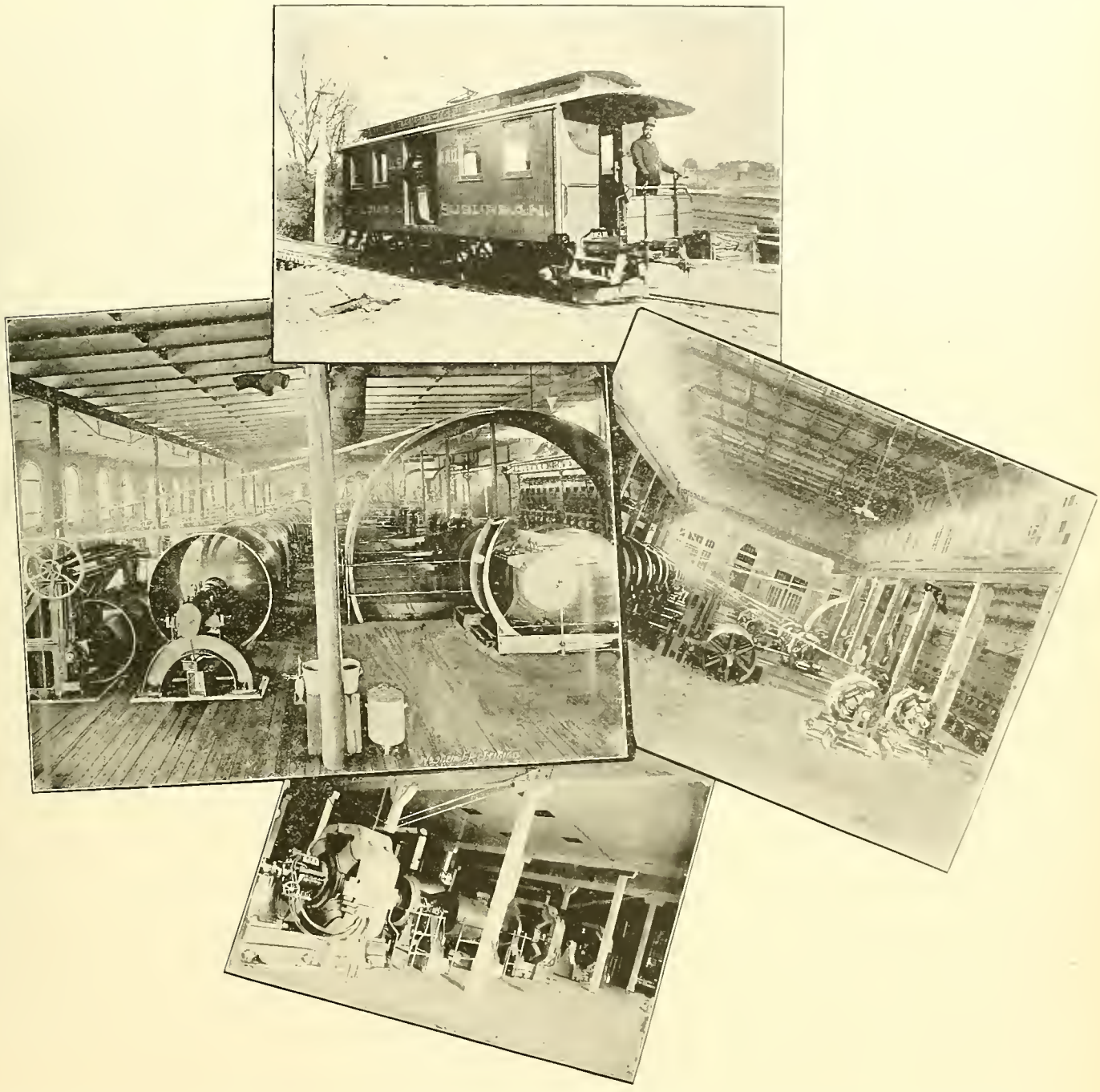
removed, and a large Corliss engine will be put in it. This will be belted to a line shaft on the second floor, from which twelve 60-light arc machines are to be driven.

D. W. GUERNSEY.

D. W. Guernsey, president of the St. Louis Electric Light & Power company, has been interested in electrical work in St. Louis from the earliest days. He began studying the problem in 1882. When at the head of the Guernsey Furniture company he put in a large arc plan for lighting his store, and shortly afterward began to furnish all day lights, using Excelsior apparatus, for some of his neighbors. Out of this sprung the Guernsey-Scudder Electric company, which finally equipped an independent station on Locust street, and in 1889 was merged into the Municipal Electric Light & Power company. The present company did an exclusive power business for many years, and it is claimed that this station was the first exclusively power station in the country. Mr. Guernsey is an enthusiast in his work. For many years he was the western representative of the Sprague Electric Railway & Motor company, and put in many of the original Sprague railway installations in the West. In December, 1889, the Locust street building was destroyed by fire; but within five days a temporary plant had been equipped, and the complete service of power distribution had been resumed.

WAINRIGHT BUILDING.

Among the tall buildings of St. Louis one of the most attractive and substantial structures is the Wainright building. A feature of this structure is a model isolated lighting plant, illustrated herewith, which was installed by the Thomson-Houston company. There are three dynamos of the Thomson-Houston make of 600 lights each, and one of 200 lights. The switch-board is made of black enamelled slate; the instruments and copper work on the board are highly polished and lacquered and present an attractive appearance. It is one of the most modern switch-boards installed in this section of the country. On the switch-board is one large current indicator of 1,300 ampere capacity, which indicates the total current supplied. The building is fed by a system of four feeders, each being supplied on the switch-board with a large single pole switch. There are 2,000 sixteen candle power lamps wired up complete in the building and in operation. Rubber-covered wire and the interior conduit system are used. This plant was installed by the isolated department of the western office of the Thomson-Houston company, Chicago.



VIEWS OF ELECTRIC RAILWAY PLANTS IN ST LOUIS.

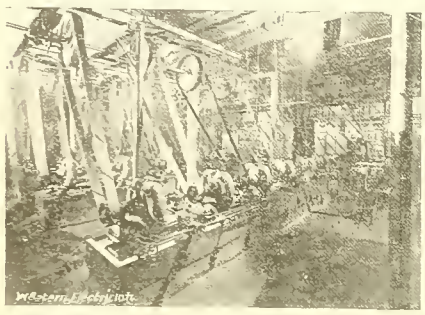
ST. LOUIS AND SUBURBAN ELECTRIC RAILWAY.

Built in 1876 as a narrow gauge steam railway from Grand avenue and Olive street to Florisant in St. Louis county, this line continued to be operated by steam until the summer of 1891. About 1885 the down-town portion, from Sixth and Locust Streets to a transfer depot near Vanderventer avenue and Morgan streets, was constructed as a cable road, and was so operated for many years. Being the first cable road in St. Louis, it proved highly successful and resulted in an immediate movement on the part of the other street roads toward rapid transit. On account of the large number of curves and the round-about line which it followed, it proved a very expensive road to operate. In the spring of 1891 a reorganization was effected, and after a thorough investigation into the subject it was decided to abandon both the cable and steam systems and equip the entire line with electricity. This was taken promptly in hand, and the new system was completed and in good service early in October, 1891. The narrow gauge division was widened to the standard gauge and an entirely new equipment of rolling stock was provided, besides building a very substantial road bed throughout the entire line. Its service has been very satisfactory, and the line has proven popular and profitable. The total mileage of single track is 28.22; of this all that portion lying within the city limits, including a loop of one mile on Unio avenue to Forest Park, is double track. From the city limits to the western terminus at Florisant there is a single track with turnouts at intervals of one mile. The extreme distance from eastern to western terminus is eighteen miles.

The power station is located at DeHodiamont, on the Wabash railway, six miles from the eastern terminus, and twelve from the western. The feeders are so distributed that the drop at the most extreme points never exceeds 15 per cent. A switch from the Wabash railroad permits the delivery of coal directly in front of the boilers. The latter are eight in number, of the horizontal tubular type; two of them are 66 by 20, and six of them 70 by 18. There is an independent iron stack for each pair of boilers. The electrical equipment of this station is 1670 horse power, and the steam plant can be worked up to 2000. There are three Hamilton-Corliss engines, each of 800 horse power

capacity. These are belted to lines of counter-shafting, from which, by means of friction clutches and pulleys, the generators are driven, it being possible to throw out any generator or engine at any time, without interrupting the others. There are twelve Thomson Houston generators, eight of 100 horse power each, two of 107, and two of 333 horse power capacity each.

The average number of cars in daily operation is from forty-two to fifty, mostly of the double-truck pattern, 21 and 28 feet bodies. Trailers are operated occasionally, when the traffic demands. Each of the 21 foot cars is equipped with two S. R. G. 15 horse power motors; the 28 foot motor cars have two W. P. motors of 25 horse power capacity each. The overhead and ground electrical construction is of the Thomson-Houston pattern throughout. Except on the extreme western division of six miles, a supplementary wire is used, and both it and the track are well grounded at frequent intervals. Traveling cranes in



WESTERN UNION TELEGRAPH COMPANY'S PLANT, ST. LOUIS.

the engine room permit of the lifting and moving of any piece of machinery in the house.

THE BENTON AND BELLEFONTAINE RAILWAY.

This line, which runs from Fourth street and Washington avenue to the cemeteries in North St. Louis, was for many years operated as a horse car line, with "bob-tail" cars. The total single track mileage is fifteen. There are twenty cars operated on an average, and thirty at busy times. The cars are all of the long single pattern, with 20 and 26 foot bodies. Each car is equipped with two 15 horse power single reduction motors. The system used is the Thomson-Houston. The power house is located at Twentieth and Ferry streets, and consists of six return flue tubular boilers, each rated at 150 horse power. Each battery of two boilers has an independent iron stack. The engines, two in number, are of the Philadelphia Corliss pattern, each rated at 600 horse power capacity. The driving belts run directly from each engine back and alongside the engine and through the heavy tighteners to the jack shaft. To this shaft two 350 horse power generators are attached by means of a clutch coupling. It is evident, therefore, that one engine can pull one or two dynamos. Both engines can be operated when the load requires, but they are, of course, operated independently. The arrangement is a very compact one and has many good features, not the least of which is the low first cost and small space occupied.

UNION DEPOT RAILWAY.

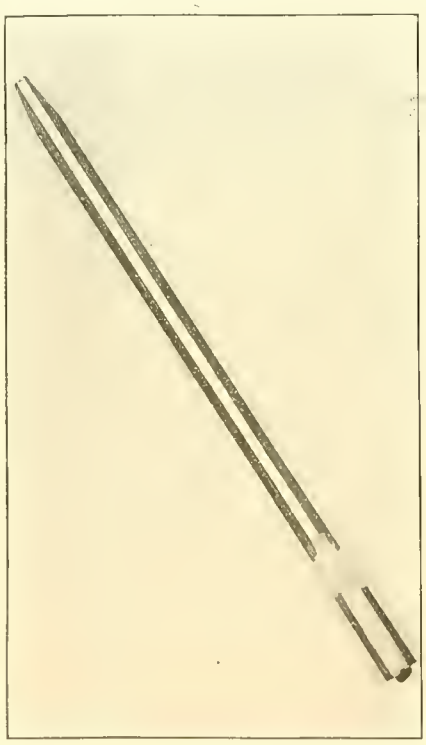
One of the most extensive electrical systems in St. Louis is that of the Union Depot Railroad company, which also operates the Mound City line. Its extensions reach to the fair grounds on the north, to Tower Grove park on the west, and over half way to Carondelet on the south, the numerous branches and ramifications making a total of thirty-two miles of single track. Seventy-five motor cars are operated, trailers being used regularly during the busy hours. The cars are run on very close spacing and make good time. Each motor car is equipped with two 15 horse power motors. Eighteen of the cars are 34 feet in length and have a center radial truck; the remaining cars are 28 feet long. The power house, which is located at Geyer and Missouri avennes, is equipped with twenty-two Thomson-Houston generators of the old bi-polar style, each having a capacity of 62½ kilowatts; speed, 950. The transmission is by means of belting to a jack shaft, thence to a countershaft extending the entire length of the building and on which are located friction clutches and pulleys. There are four Hamilton Corliss engines, each running 80 revolutions, one 20 by 42, another 24 by 44, and the remaining two 28 by 54. Speed of the countershaft is 325. Steam supplied by seven 250 horse power Heine safety water tube boilers, equipped with the Hutchinson smoke preventer. This device has materially reduced the smoke, but has not altogether stopped it.

ELECTRIC MAIL CAR OF THE ST. LOUIS & SUBURBAN RAILWAY COMPANY.

One novelty in the way of electric traction on the St. Louis & Suburban railway, now in successful operation is the application of electric motors to a United States mail car, which makes regular trips over the entire line, distributing and collecting the mail at the railway stations, as is done on steam railways. This car is of the same length as an ordinary steam railway mail car, and is equipped with double trucks with 36 inch wheels, a Thomson-Houston motor of 15 horse power capacity being connected to each truck. A very high speed is attained, and the delivery and collection of mail is made without stopping the car, as in steam service. It is claimed that this is the first mail car that has been electrically equipped in this or any other country.

FIRST ARC DYNAMO IN ST. LOUIS.

A representative of the WESTERN ELECTRICIAN spent considerable time in a vain endeavor to locate the first arc dynamo operated in St. Louis. He managed to secure the full history of that interesting event, but the machine itself long since fell a victim to the ruthless destroyer. A party of St. Louis gentlemen attending the World's Fair in Paris in 1878 were greatly interested in the primitive arc lighting, which they found just coming into use. Adolphus Busch, one of the party, now president of the Anheuser-Busch Brewing association, determined that such an installation must be brought to St. Louis. This was not an easy undertaking, as the manufacturers were not ready for a wide-spread dissemination of their ideas. Mr. Busch was accompanied by Tony Faust, in whose restaurant the plant was to be erected. The latter was finally obliged to enter into an iron-clad agreement that the apparatus would be used only at the particular location named and for a specific purpose. No electrician was brought to America to erect the apparatus, but drawings and instructions in French were furnished. The apparatus consisted of a Gramme dynamo and a supply of Jablochkoff candles, which were then used in place of arc lamps. At that date no one in St. Louis had had any experience in electric lighting, and the erection of the apparatus was intrusted to Charles Heisler and his assistant, William Wurdack. The latter gentleman has been connected with the Heisler in-

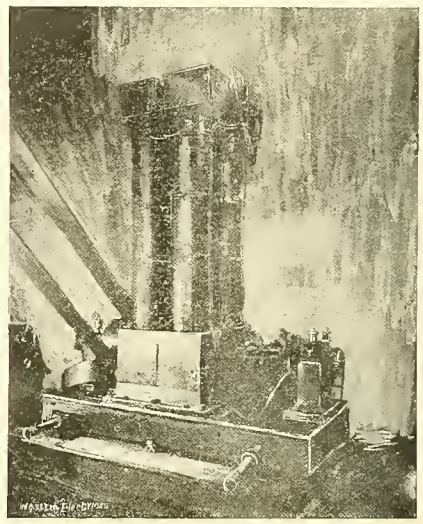


JABLOCHKOFF CANDLES USED IN THE FIRST ST. LOUIS PLANT.

terests for many years, and is now president of the Interstate Complete Electrical Construction company, a view of whose works, accompanied by a photograph of Mr. Wurdack, appears on another page of this issue. The plant was started successfully, and was run for about a week with insufficient steam power. The trouble from this source proved so serious that the operation of the plant was discontinued. The dynamo itself was shortly afterward removed to the Anheuser-Busch brewery, where it was erected with new lamps somewhat similar in type to those now commonly used. It ran successfully for several years in the wash house of the brewery, and was finally turned over to Heisler, who used it in experimental work, developing an arc system of his own. The influence of the early Gramme machine is clearly shown in the present standard machines of the Heisler company. This first dynamo was so transformed in the Heisler shops as to be unrecognizable, and was finally dismantled. A view of one of the Jablochkoff candles, which came with the original shipment from Paris, is presented in the cut. It is interesting to note that on the occasion of the next World's Fair in Paris in 1889 Charles Heisler of St. Louis exhibited a complete incandescent system of such novelty and merit as to win a gold medal.

FIRST INCANDESCENT DYNAMO IN ST. LOUIS.

The first incandescent dynamo which was operated regularly for commercial purposes in St. Louis is illustrated in the cut. This dynamo is of the old style Edison type.



FIRST INCANDESCENT DYNAMO IN ST. LOUIS.

It is curious to note the size of this 150 light dynamo. It stands seven feet high from floor line, something wonderful when compared with machines of the present day. It is now in daily operation at the works of N. K. Fairbank & Co., on Third and Convent streets. It was originally installed in the spring of 1882, and has consequently seen eleven years of continuous service. Its capacity as originally rated was 150 lights, and it was driven by a 6½ by 8 Armington & Sims engine, 18 horse power. The dynamo has, however, frequently been called upon to run over 300 lights, and has done so satisfactorily. It bears the name plate of the "Edison Company for Isolated Lighting" and is numbered 45. Its speed is 1,200. It has just received an overhauling, and the superintendent considers it good for ten years more of hard service—in fact, the men in charge of the plant think more of this veteran than of the more recent forms of machines running alongside of it. The plant was originally installed at the old Fairbank works, on Main and Washington streets, but was removed about five years ago to its present location.

WESTERN UNION TELEGRAPH COMPANY.

By no means the least interesting feature of the city is its extensive telegraph service. The most interesting part of the Western Union outfit is the plant in the basement. The dynamos, which supply current both for lighting the building and for operating the telegraph circuits, are shown in the accompanying cut. There are twenty C. & C. dynamos, each of 1.5 kilowatts capacity. One operates at 10 volts for the local circuits, another at 30 volts takes care of the city loops. The remaining eighteen operate at 75 volts, and are so coupled as to give currents of pressure up to 375 volts, which is required for the longest circuits. These dynamos are in three units, each driven by a 6 by 10 Rice engine, at 275 revolutions, belted to a countershaft from which belts are taken to the dynamos. The present plant takes the place of 20,000 cells of battery, and has a capacity equal to 100,000 cells. A 40 horse power Rice engine operates a 400 light United States incandescent dynamo, from which 300 incandescent lights and six arc lights are operated for the building.

ST. LOUIS ELECTRIC CLUB.

Prominent among the electrical features of St. Louis is the recently organized electric club. It has now been placed upon a substantial footing, with a membership of nearly 100, including practically everybody in St. Louis who has in any way been identified with the development of her electrical enterprises. Commodious quarters have been engaged on the second floor of the Equitable building, a central location, and have been handsomely furnished. It is expected that the club will take a prominent part in entertaining the delegates to the convention.

The programme of entertainment arranged by this organization was presented in the last issue of the WESTERN ELECTRICIAN. Following are brief sketches of a few of the prominent members of the club:

Capt. Robt. McCulloch (Fig. 1), president of the Electric club, is 50 years of age. He is the St. Louis representative of the Chicago syndicate owning and operating the Broadway and Citizens' cable lines, and the Cass avenue, Northern Central and Union lines now being changed from horse to electricity, which, together with the Benton-Bellefontaine electric road, makes a total of nearly 100 miles under his direct management. At the time of the war Captain McCulloch was a cadet in the Virginia Military Institute, and went from there into the confederate service with Stonewall Jackson, following the fortunes of General Lee for four years. From Virginia he went to St. Louis in 1869, and shortly after was connected with the Benton-Bellefontaine railway, with which he is still identified. Early in 1889 he took hold of the Citizens' cable road, and the Cass avenue Northern Central and Union horse lines. In the summer of the same year he also assumed the management of the Broadway cable line. The new Cass avenue electric power station, which he is now building, is in harmony with the latest advancements in electrical science and possesses many novel and interesting features. The captain is a firm believer in the electrical railway, and recently expressed the opinion that no more cable roads would be built. He did not think, however, that existing cable roads would be changed to electricity, as cable plants represented too large an investment to be abandoned. The Grand avenue branch of the Citizens' cable line in St. Louis is, however, to be changed to electricity, as the cable power house is now overloaded.

Prof. F. E. Nipher (Fig. 7), vice-president of the electric club, has been professor of physics in Washington University since the fall of 1874. There was then no department of electrical engineering. Electrical operations in the arts were confined to telegraphy, electro-plating and house-bell installations. The first dynamo brought to the city was probably in 1877, when Professor Nipher was invited to view a Brush machine on exhibition at the store of M. M. Buck. In 1878 he also visited the Gramme machine, which was installed at Faust's. A little later he was consulted by Charles Heisler, who was beginning to develop an electrical manufactory, and for a time was associated with the Heisler Electric Lighting company, but soon sold his interest in the concern. Later when Heisler began the manufacture of carbons he found it impossible to plate them with copper. The acid liquid within the carbons destroyed the carbon plating within a few hours. The firm had large orders and could not fill them. Professor Nipher was called in and at once advised that the carbons be saturated in gasoline before placing them in the vat. This device worked perfectly, the gasoline preventing the acid copper solution from entering the carbon, and all of the carbons manufactured by the Heisler company were made by this process. In 1883 Professor Nipher was called to pass upon plans of Dr. Adams for propelling street cars by electricity, and when early in that year the Adams Electric company was formed for developing these plans into practical shape, he became a director and consulting electrician in that company, and soon after became president of the company, which position he has since held. Prof. Nipher has been placed at the head of the project proposed by Dr. Adams of building an electric railway from St. Louis to Chicago, on which cars are to be operated at an average speed of one hundred miles per hour. Prof. Nipher's work in developing the course in electrical engineering in Washington University is well known, and his students have found themselves able to take honorable positions in competition with men from eastern schools. He is a past-president of the St. Louis Academy of Science, and of the St. Louis Engineers' club, and has contributed many electrical papers to the publications of these societies. His book on the "Theory of Magnetic Measurements" is used in several eastern schools and by the U. S. coast survey and the U. S. navy as a book of instruction. Prof. Nipher is a native of New York, and is 45 years of age.

W. L. B. G. Allen (Fig. 4), is a native of Fairhaven, Mass. He first entered the electric business in 1880 as secretary of the Brush Electric association of St. Louis, agent of the Brush Electric company for the south and southwest. This association formed lighting companies at Memphis, Chattanooga, Nashville, Louisville, Columbus, Savannah, Montgomery, New Orleans, El Paso, Little Rock, Denver and Topeka, and built the first lighting station at St. Louis. Afterward Mr. Allen was president of the United Electric Light & Power company of St. Louis, consisting of the combined stations of the Brush, Thomson-Houston, Excelsior, Western and Heisler companies, and at the same time manager of the Electric department of the Laclede Gas Light company. He is now president of the St. Louis Engineering company. He is one of the most active members of the electric club, being its second vice-president, a member of the board of managers and a member of the most important committees.

C. R. Scudder (Fig. 5), has been connected with electrical work in St. Louis for many years, although but 30 years of age. He is now secretary of the Electric club and secretary and treasurer of the St. Louis Electric Light & Power company, the pioneer in the motor business in St. Louis. In 1884 Mr. Scudder was interested in the Guernsey Furniture company, which, in addition to operating its own arc lights with Excelsior apparatus, rented a few to neighboring stores. This business developed so rapidly that the Guernsey-Scudder Electric Light company was formed. This plant was afterward removed, and passed through various ownerships, being finally merged into the Municipal Electric Light & Power company, with the other arc stations in the city. Mr. Scudder takes an active part in the Electric club and in the reception of the delegates to the National Electric Light convention.

PROMINENT MEMBERS OF THE ST. LOUIS ELECTRIC CLUB.

E. J. Bagnall (Fig. 2), is 37 years of age and was born in England, but reached America when 4 years old. A large part of his life was spent in Cleveland, where he early identified himself with the Brush company at the beginning of electric light work, and was with that company for many years as foreman. In 1885 he came to St. Louis, and leased the newly constructed Brush arc station, and operated it in partnership with A. W. Dutton. When this company, with the other arc lighting companies of the city, was merged into the United Electric Light company, Mr. Bagnall was appointed general superintendent of all the plants, and continued to occupy that position until the stations were absorbed by the Municipal company. Mr. Bagnall was intimately connected with the early work in storage batteries in St. Louis, having charge of the work done by the Lindell Railway company. In 1887, when the Lindell Railway company established its electric power plant, he was appointed electrician, which position he held until a few weeks ago, when ill health forced him to give up his duties and take a trip to Cuba.

J. H. Rhotehamel (Fig. 6), is president of the Columbia Incandescent Lamp company, whose factory is located at 1912 and 1914 Olive street, and occupies a building 42 by 109 feet, three stories high and basement, equipped with a complete electrical and steam plant. Mr. Rhotehamel began this industry in 1889 at 513 Elm street. The business increased so much that the factory was removed in February, 1891, to larger quarters at its present location. The Columbia is the oldest western company engaged in the manufacture of incandescent lamps. It has grown constantly, requiring many additions to the plant. The success of this company is largely due to Mr. Rhotehamel's individual efforts. Coming to St. Louis in July, 1889, he immediately entered upon his present business, and succeeded in building up the largest electrical factory in this city. In common with nearly all other lamp manufacturers, the Columbia company ceased operations about a month ago, pending the hearing of the application of the Edison company for a temporary injunction. The case is set for March 21st, before Judge Hallett of Denver, who has been assigned to the work. The hearing will be in the United States Circuit Court for the eastern district of Missouri. Mr. Rhotehamel, whose age is 35, has perhaps as wide an acquaintance in the electrical fraternity as any one in St. Louis. He is active in electrical work, and is a member of the board of managers of the Electric club, and chairman of its committee on programme and entertainment.

Louis Nahm (Fig. 8), chairman of executive committee, is secretary and treasurer of the American Electrical Manufacturing company, which makes the American incandescent lamp. He was born in Winchester, Ky., and is 43 years old. He was educated at the Indiana Asbury University and the Louisville, Ky., Law School. He has been a resident of St. Louis about ten years and was engaged in the practice of law in Louisville and St. Louis until he took charge of the affairs of the American Electrical Manufacturing company, on account of the ill health of his brother, Ben Nahm, the president of the company. Mr. Nahm makes no pretensions to knowledge of electrical science further than that acquired by study in the lamp business, but his business qualifications and management have been of great advantage to his company. The business has increased steadily, and the company has been compelled to increase the capacity of the factory three times, the last increase having been just completed when it was compelled to close on account of the decision in the lamp patent litigation.

Col. Edward D. Meier (Fig. 3), another of the prominent Louis Electric club members, was born in St. Louis in 1841. He was educated at Washington University, afterward spending four years in the Royal Polytechnic School at Hanover, Germany, where he studied civil and mechanical engineering. Returning to America in 1862, Colonel Meier entered the Mason Locomotive Works at Taunton, Mass., as a practical machinist. He then spent two years in the army and did good work in military engineering, especially at New Orleans. After the war he entered the Rogers Locomotive Works, and thence he went to the Kansas Pacific railway as assistant superintendent of machinery, and was later on made superintendent of machinery. Returning to St. Louis in 1870, he again took up his profession as an engineer and has continued in this line up to the present time. Colonel Meier is of course best known to the electrical people as the president of the Heine Safety Boiler company, whose steam apparatus has been installed in some of the largest electrical plants in the country; Colonel Meier is on the board of managers and house committee of the St. Louis Electric club. He is a member also of the American societies of Civil, Mechanical and Mining Engineers. He is a past president of the Engineers' club of St. Louis, and is now secretary of the American Boiler Manufacturers' association.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HEADQUARTERS for the WESTERN ELECTRICIAN during the St. Louis convention have been established at the Southern hotel.

OWING to the St. Louis convention, this number of the WESTERN ELECTRICIAN is printed before the regular day of publication. The next issue of the paper will contain the report of the proceedings of the convention and a complete review of the week's happenings in the convention city.

WHILE New York is engaged in trying to convince itself and the rest of the world that an underground system of electric railway would not prove profitable and desirable, Boston railway men are petitioning for the right to construct a tunnel system through the heart of the city as the only possible solution of the rapid transit problem for outlying districts. Still New York persists in claiming that it is the foremost city in the country. It is losing its standing as a progressive American city and will soon be numbered among the "has beens" unless its capitalists are aroused to a realization of the impending danger. In rejecting the plans of the rapid transit commissioners for an underground electric system the capitalists of the American metropolis inflicted an injury upon property in that city from which it will not recover in many years.

THE mention of Col. R. C. Clowry of Chicago, vice-president and general superintendent of the Western Union Telegraph company, as a possibility for the position of president gave an opportunity for an expression of the high esteem in which Col. Clowry is held in this city. It is the general opinion, however, that Gen. Eckert, first vice-president, will succeed to the vacant position, for which he has exceptional qualifications, and we are sure that no one will approve the choice more heartily than Col. Clowry, who is in no wise responsible for the rumors linking his name with the place. It may not be out of place, however, to remark that the people of Chicago—or at least that large proportion of them who come in contact with the head of the Western Union system in this city—will heartily rejoice in any preferment that may come to Robert C. Clowry. We doubt if there is a man in the service of the company who is better liked. As the *Chicago Evening Post* remarks, "A more courteous and capable semi public official we cannot imagine." May he live long and prosper!

DELEGATES to the convention of the National Electric Light association at St. Louis will find this week's issue of the WESTERN ELECTRICIAN particularly interesting and instructive, presenting, as it does, in a comprehensive manner, illustrations and descriptions of the principal electrical features of the city. Managers of central stations for arc and incandescent lighting, railway and power plants and owners of isolated installations, will find many novelties in the stations which furnish St. Louis electric current. It may be said that from an engineering view point the work will compare favorably with that of any city in the world. The equipments are of the most approved design and the best modern methods have been employed. The excellent service which the city receives is the best evidence that can be desired that the stations were built and quipped in the most approved manner. St. Louis is to be congratulated upon securing such admirable service, and the managers of the immense lighting, railway and power plants are deserving of praise for presenting this object lesson to the country. It would seem that the people of St. Louis appreciated the efforts of the electrical companies and were ready to give substantial evidence of their approval.

PARIS has been frequently alarmed by explosions since the development of electric lighting has necessitated a vast extension of the underground distributing system. Fortunately little damage has accompanied these occurrences, and the same general statement can be affirmed of like explosions on this side of the Atlantic, though Paris has fared rather better than Chicago, with whose record in this respect we are most familiar. That the damage has been slight is attributable to sheer good fortune, for the possibilities of destroying life and property are undeniably great. A case in point occurred in Chicago a few days ago. A manhole cover was thrown into the air with tremendous force, and narrowly missed in its career several vehicles and a passing street car. The causes of the phenomena in Paris are discussed at length and in great detail by M. P. Jousselin in a paper presented elsewhere in this issue. Were this matter treated by a Chicagoan we might expect the special consideration of two points: ventilation and insulation. A reference to the normal leaky condition of gas mains also would certainly be forthcoming. Jousselin's paper by no means follows this skeleton. He does not allude to ventilation, the matter of insulation is almost incidental, and all faults in gas pipes, as far as his paper extends, are wholly attributable to the deleterious and disintegrating effects of electric currents wandering from the proper path. Assuming that the explosions are caused by escaping gas, and that the leaks are due to the proximity of electric currents, he notes two classes of perforations in the pipes. The first are produced by the actual contact of cable and pipe, and the second are caused by electrolytic action. He selects a type of the first class and investigates it in its minutest details with all the patient enthusiasm of a French scientist. This case has no mystery about it; it was the result of the most abominable carelessness. We would like to say that this bit of work by which a lead covered cable and a lead gas pipe were left in contact in a manhole was surprising and unaccountable; but, unfortunately, wretched bungling of this sort is not confined to Paris. The general statement of the mode in which the pipe was perforated may be accepted as a fact, but we are inclined to believe that Jousselin is a trifle too exact in his detailed explanations. His statement of the exact time which elapsed between the perforation of the pipe and the explosion, for example, does not leave room enough for uncertainties. The painstaking care which led him to investigate every element, however, is admirable, and his account is interesting.

The second class of leaks, due to electrolytic action, is numbered by the hundred in Paris, according to Jousselin. The ground under the streets is very largely composed of sulphate of lime. When leaks of current occur a chemical reaction in the earth eosues, and sulphuric acid is carried to gas pipes to which the current escapes. Holes are eaten in the metal, and the gas escapes, following the conduit to the manhole, where mixture with air forms the material for an explosion. Though Jousselin states that this theory is proved by investigation and chemical analysis, we rather question its universal applicability even in Paris. There must be leaky gas joints in Paris as well as leaky conductors of electricity, and they ought to stand their share of responsibility. The explosions are decreasing in number, and Jousselin has faith that in the future gas pipes and electric cables may be placed in juxtaposition without endangering life and property.

PATENT legislation has been needed in this country for many years, and has been persistently advocated by those most familiar with the workings of the present system. The commissioner of patents has advocated comprehensive measures for improving the service, and correcting existing evils, and although he has addressed petitions and communications to congress upon this subject, that body has not seen fit to take effective measures to perfect the system. It is quite probable that public attention will be attracted to this subject by the litigation begun by the attorney general in behalf of the government to annul the Berliner Patent. The general use into which the telephone has come makes this litigation interesting to a large portion of the people. Telephone subscribers who have been grudgingly paying the high charges imposed by the Bell company have been anxiously awaiting the expiration of the fundamental patent upon which the company maintained its right to the exclusive control of this service. And now when the patent is about to expire, the announcement that another patent has been secured, which will enable the telephone company to continue the present monopoly, is received with indignation by present subscribers and others who hoped to be able to secure telephone service as soon as the present rates were reduced. This fact coupled with the charges made in the complaint filed by the attorney general, has not improved the public feeling toward the telephone company. It is but natural that there should be resentment toward the Bell company, and that those who may have to suffer from the continuation of the present monopoly should feel a live'y interest in the patent system under which the company is enabled to exact exorbitant charges for its services without fear of competition. The fact that the Berliner patent which was granted November 17, 1891, was pending in the patent office since June 4, 1877, is the best possible evidence of the urgent necessity of immediate revision of the existing laws. The need of a radical reform in this department is all the more apparent when it is charged that this delay was in a large measure, at least, caused by the company in whose interest the patent was granted. The attorney general in his elaborate complaint shows that it is possible, under the present mode of procedure, to delay the granting of a patent by introducing irrelevant and fictitious claims, and thus causing a controversy which will occupy considerable time and defeat the intent of the patent laws. Aside from the charges of fraud on the part of the telephone company in causing the application of Berliner to be changed so as to cover an entirely different invention, it is asserted that the company contributed materially to the delay by causing the invention to be declared in interference with other applications, also owned by the Bell company. The reprehensible proceedings which it is claimed the telephone company was guilty of are not the first of the kind in the history of the patent office, but the fact that the result of these alleged machinations will seriously affect a great number of the people of the country, may possibly have the effect of securing a revision of the entire patent system. If such a result should follow, the scandal caused by the present litigation, while deplorable, might ultimately terminate in a great public gain. Aside from the merits of the present controversy it is a matter of public congratulation that the present action was begun, as it will serve to point out the defects in the patent system and direct public attention to the necessity of immediate legislation.

Dangers from Gas in Electrically Lighted Cities.[1]

By M. P. Jousselin.

Several accidents to which I desire to call your attention show that the location of electric conductors in relation to gas pipes is a matter of no slight importance. On the contrary it is necessary to take the utmost precautions to prevent results, often dangerous, arising from the proximity of the two means of distribution. The accidents to which I shall allude have resulted from the perforation of gas pipes by electric currents from neighboring conductors. Two distinct classes may be noted. The first includes perforations due to short-circuits and the second those caused by electrolysis. Four or five of the former have been noted during the last few years, of which the most important was that which caused the explosion at the

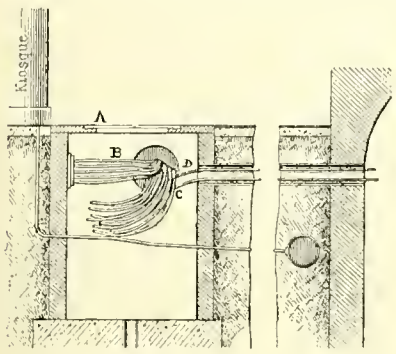


FIG. 1. DANGERS FROM GAS IN ELECTRICALLY LIGHTED CITIES.

Larue restaurant in Rue Royale. This accident was of such a well defined character that it may be taken as a type of this class. It may be worth while to note some of the particulars of the explosion, which occurred about 9:30 P. M., March 2, 1891. With the exception of two persons seated at the end of the dining saloon the patrons had left the restaurant, but their escape from injury was a little short of miraculous. The loss was limited to the destruction of furniture, wines and provisions and to serious damage to the building. The loss to the proprietor, however, due to the closing of the place during repairs, was quite considerable.

The cause was evidently an explosion of gas, and it remained to discover how it was produced. On the morning of the day when the explosion occurred odors believed to be due to the escape of gas were noticed in the restaurant and in the cellar below it. The gas company was notified and its employes proceeded to make the necessary inspection. They uncovered the principal main under the sidewalk, made an inspection in the cellar; they even used a light, but the inspectors and workingmen discovered nothing. They believed, however, that the odor was suggestive rather of burned caoutchouc than escaping gas. In the evening the smell became even stronger and the gas company was again notified and it promised to renew the investigation on the morrow. Then the explosion occurred. The representatives of the Popp company, which furnished light for the restaurant, as well as the agents of the Parisian Gas company, proceeded immediately to make investigations. Their disagreement necessitated the interference of a referee to decide upon the examination.

When on the same day the experts reached the scene of the explosion, here is what they found: No gas pipe supplied the Larue restaurant, as it was lighted entirely by electricity. The two electric conductors furnishing current for the establishment entered the cellar through pipes

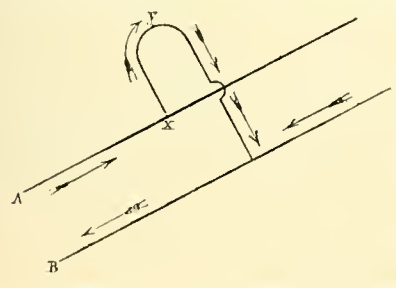


FIG. 4. DANGERS FROM GAS IN ELECTRICALLY LIGHTED CITIES.

which extended under the sidewalk. These conductors were branches of the Popp system which passed under the walk at the foot of a newspaper stand, Fig. 1.

When the manhole cover, *A*, was lifted it was possible to note the state of the cables: At the top were five small high tension cables, *B*, and below were the low tension cables, *C*. Two of the latter were connected with the two conductors, *D*, which entered the restaurant. Part of the high tension cables (2,500 volts) supplied the street lamps and the remainder (1,800 volts) carried current for charging storage batteries. The low tension cables carrying current at 110 volts supplied the private establishments. The high tension cables were composed of silicon bronze wires covered by caoutchouc, and protected by a lead sheath, which was surrounded by rubber and tar wrapping. The outer cover of the low tension cables was a bare lead sheath. Below the latter conductors a lead gas pipe was noticed, which touched one of the low tension cables, and it was seen that at the point of contact there was a perforation in the pipe. When the pipe was cut so that it might be examined, a second hole was found, which was conclusive that at this point, also, there had been contact with one of the cables. The pipe was used for supplying the single gas jet in the newspaper kiosk.

When the Popp company had made the excavation for the manhole it encountered this pipe, which was covered with tile in accordance with the ordinance. Without notifying the gas company, which would have changed the direction of the pipe so that it would have been outside the manhole, the workmen of the Popp company left it inside, fitting it into the masonry, but without its tile covering, which had been demolished during the progress of the work. The bare lead pipe was thus exposed to contact with the low tension cables.

Of the two holes in the pipe, Fig. 2, one was nearly round, 6 millimeters in diameter and of crater form appearance; the other, elliptical in form (4 by 12 millimeters), had the same crater form appearance, and had on its upper lips drippings of lead, indicating that fusion had commenced.

It was through these holes, the cause of which will be explained later, that the gas escaped into the cellar by the leading-in pipes of the two electric light cables, and formed with the air the mixture which led to the explosion.

I should observe here, and I will take up the matter later, that the coverings of the five high tension cables traversing the upper part of the manhole were burned for a distance of 25 millimeters. The copper was entirely bared; the lead, caoutchouc and tar wrapping had been burned, and had disappeared. The wooden moulding for holding these cables had been carbonized for the same distance, and the zinc screen which protected the molding and cables from the rain-water leaking in at the cover of the box had been melted at corresponding points. The denudation of the cables for a distance of 25 millimeters on the one hand and the appearance of the perforations in the gas pipe on the other hand, indicated that intense heat had been generated at these points.

The electric currents traversing the cables were certainly the only means of developing the heat necessary for producing the effects noted, and the two perforations in the gas pipe were due to the production of an arc resulting

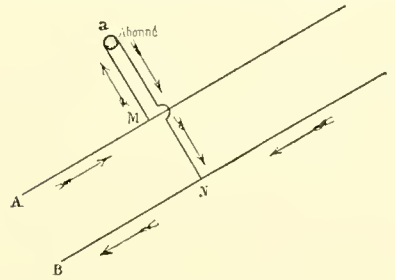


FIG. 3. DANGERS FROM GAS IN ELECTRICALLY LIGHTED CITIES.

from a short circuit. This view sustained the position of the Parisian Gas company.

On the other hand, the Popp company, which endeavored to escape all responsibility for the accident, claimed that nothing demonstrated absolutely the production of such a phenomenon, and it offered to present in my presence at its central station a series of experments which would prove that the production of a short-circuit was by no means essential, even in the conditions found in Rue Royale. On the other hand the gas company proposed similar experiments at its little electric station on Rue Condorcet, and it agreed besides to construct a manhole arranged in all respects like that on Rue Royale, so that all conditions of the accident could be reproduced.

I assisted at the experiments of both companies, and I shall describe them later, dwelling more particularly upon those of the gas company, which were complete in every respect and which enabled the experts to arrive at a definite opinion. I should remark that it was impossible for the experts to attribute the perforations to any cause outside of electrical phenomena, for it was shown:

First, the two holes could not have been caused by a workman's tool. The examination of the pipe demonstrated that beyond all question. Second, the holes could not have resulted from faults in the manufacture; the pipe had a normal appearance without trace of flaw or crack. Third, the holes could not have been produced by excess of pressure of gas, for the thickness of the pipe was constant; there was no thinning of the metal at any point. Besides the maximum pressure is never great enough to cause any such effect.

Before entering into the details of short-circuits the general theory of these phenomena should be explained. The companies to which have been conceded the sectors of Paris for electric lighting and transmission of power use for the distribution of currents a greater or less number of cables, but never less than two. These cables have cores of copper or silicon bronze. They are located under the sidewalks, in accordance with arrangements which vary in each sector. Let us assume that two cables *A* and *B*, Fig. 3, supply a customer at *a*. A customer's installation, generally speaking, is branched on the two cables by means of two conductors, each of which is connected to one of the cables. Assume *M* and *N* to be the points at which the conductors of the customer *a* are attached to the mains.

If we call E the difference of potential between *M* and *N*, R the resistance of the subscriber's installation, C the quantity of current which traverses the installation, then C can be determined by Ohm's law, or $C = \frac{E}{R}$. The same thing applies to any conductor whatever, as *X Y Z*, Fig. 4, connected to the two cables *A* and *B*. Let us assume that no chemical action is present or any mechanical effect is produced, as is ordinarily the case in a subscriber's circuit. Then assume the same quantities as before $C = \frac{E}{R}$. The heat freed per second along the conductor according to Joule's law is proportional to $R C^2$. If we call Q the quantity of heat and k a constant we will have $Q = k R C^2$ and substituting the previous value of C, i. e., $\frac{E}{R}$, we have $Q = k \frac{E^2}{R}$. This formula shows that if E has a constant value, as is the case with the cables in the streets, the heat liberated per second will be greater or less just as we assume greater or smaller values for R. Thus the heat liberated per second along the conductor varies inversely as the distance, and in certain cases its value is considerable, as was the case with the cables in front of the Larue

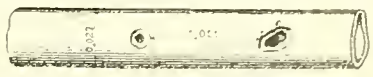


FIG. 2. DANGERS FROM GAS IN ELECTRICALLY LIGHTED CITIES.

restaurant. But, generally speaking, this heat is not equally distributed over each unit of length, for to establish such a condition it would be necessary that the resistances of all parts of the system would be the same. If one, two or more parts have greater resistance than the others they would liberate the most heat. It is for this reason that while in an installation sufficient heat is liberated to render the lamps luminous, the conductors which have, so to speak, no resistance compared with the lamps, are subjected only to an insignificant rise of temperature.

The earth plays an important part in electrical phenomena. It is used for the return wire in telegraphy, so that it is necessary to use but one wire in connecting two stations, and it fulfills this function admirably, its resistance being practically nothing.

If both the cables *A* and *B* have one or more faults in insulation by which they communicate with the earth, then they will be connected, as by the conductor *X Y Z* in Fig. 4. Current will pass from one cable to the other by the earth connection and a short-circuit is produced. Heat will be manifested at the points of contact and in their vicinity, for they form the resistances. There may follow in certain cases electrolytic action, which, in combination with the calorific effects, will accelerate generally the destruction of the insulation.

Let us now suppose that we cause cable *B*, Fig. 5, to communicate with a pipe *G*, which forms a part of a gas system. We would then open a new path for the current, which would present scarcely any resistance, for the pipes in the public streets are almost perfectly earthed. In accordance with the laws of electricity the current passing from one cable to the other will divide. One portion will pass through the gas pipe, and at the point of contact between the pipe and the cable there will be a concentration of heat. It is this which constitutes the short circuit which produces a voltaic arc at this point. This is the only resistance which must be considered in the new path connecting the cable *B* to earth.

These preliminaries being settled, I now reach the explanation of the conditions which led to the perforations noticed in the gas pipe in the Larue manhole. On one of the circuits of the Popp company a low tension cable was certainly grounded at some point. It may have resulted

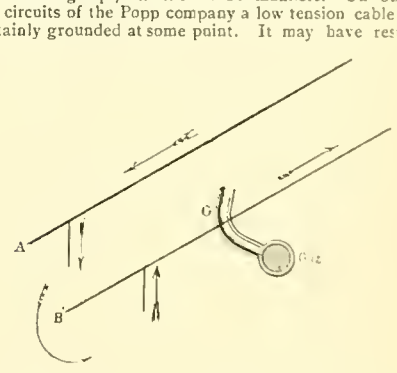


FIG. 5. DANGERS FROM GAS IN ELECTRICALLY LIGHTED CITIES.

from some fault in insulation (which unfortunately happens often enough in the manufacture of cables) or through some mistake in reeling it or in unreeling it when it was laid, so that the copper came in contact with the lead covering, or in consequence of an excess of current, which, softening the insulation at some point, permitted the lead to sink into contact with the copper, or because of an innocent nail passed through the cable connecting the copper and the lead. This last case is unfortunately frequent.

It happened thus that the copper core of one of the cables was brought into contact with the lead cover. The low tension cables hung freely across the manhole and the lead coverings touched each other. One of the latter being made alive in the manner suggested, the other covering was also traversed by current, and contact was certainly made with the gas pipe at the right of the two perforations noted.

Then a current passed from one cable to the other,

1. Abstract of a paper presented before the Society of Civil Engineers, Paris.

traversing the earth by the gas pipe and the two points where this pipe was in contact with the coverings already mentioned. At the contact points an active liberation of heat followed, and fusion and even volatilization of the pipe ensued from voltaic arcs, which caused the two perforations.

I may add that water from condensation—and there evidently was water from condensation present—dripping along the lead covering and coming between the latter and the pipe could have insured the contact sufficiently to establish the connection and produce still more speedily the perforation of the pipe. One part only of the current passed through the gas pipe, the rest left at all points where the covering could communicate with the earth. There were produced at these points calorific and destructive phenomena which may have assumed greater or less intensity before the perforation of the pipe, but by reason of the small resistance that the path through the pipe presented the greatest part of the current tended to pass through it either by immediate contact or by the dripping water. Then the short circuit followed and instantly thereafter the phenomenon of perforation was produced.

To demonstrate the actuality of the phenomenon we asked the Popp company and the gas company to make, in addition to the experiments that they proposed of their own accord, one in which a gas pipe and cables should be used similar to those found in the Larue manhole. The first experiments were given by the company at its station. Its engineers availed themselves of a dynamo generating current at 500 volts. When the cable and the lead pipe were caused to make good contact the latter was punctured. But when at the point of contact there was introduced a resistance of 50 ohms the total resistance of the circuit increased considerably, the current fell to 10 amperes and under these conditions the pipe was not punctured. The Popp company inferred from this that under certain circumstances the perforation could not be produced.

It follows from Joule's formula, which has been cited, that with a current of ten amperes an arc is not produced if the contact between the cable covering and the pipe is good.

At the experimental electrical station of the gas company there had been constructed a manhole, arranged in all respects like that in Rue Royale. There, in accordance with plans of M. Potier, experiments were made similar to those made by the Popp company. A cable and pipe were disposed as we have said, and current was furnished by a dynamo in the station. Contact between cable and pipe was produced by dripping water which caused a voltaic arc. The experiment was repeated many times, and every time punctures were made which had the same appearance as those in the service pipe in Rue Royale. The experiments were made with a potential of 104 volts, which corresponds to that employed in the electric systems on the several sectors of the city. The perforations were harder to produce when a lower potential was taken, but still our general opinion was confirmed.

Wishing to investigate the reasons which had prevented the perforation of the pipe in one of the experiments of the electrical company, we asked the gas company to increase the resistance of the circuit gradually. The resistances introduced successively were, first $\frac{3}{5}$ ohm, second $\frac{3}{4}$ ohm, third 1 ohm, fourth 3 ohms. The results were: With $\frac{3}{5}$ ohm or $\frac{104}{(\frac{3}{5})} = 173$ amperes; with $\frac{3}{4}$ ohm or $\frac{104}{(\frac{3}{4})} = 138$ amperes; with 1 ohm or $104 = 104$ amperes; with 3 ohm or $\frac{104}{3} = 34$ amperes. The pipe was invariably punctured with the resistances of $\frac{3}{5}$, $\frac{3}{4}$ and 1 ohm, but in our presence the perforation was not caused with 3 ohms resistance. This seemed to prove that when the resistance was increased beyond a certain limit the effect was not produced. This explained why no perforation had been obtained in the electric company's test.

I should add, however, that, according to some of the electricians, perforations of the pipe could be produced with a resistance greater than three ohms. Generally speaking, by causing a current of even less than three amperes to pass there was produced at the contact a persistent arc which punctured with a crater-form hole. If the current is increased to ten amperes and the cable is applied against the pipe to increase the force of contact, the arc ceases; this was certainly the case in the experiment.

However, the current mentioned above, and possible with a perfect contact, was never attained in the manhole, for the heat at the point of contact increased the total resistance of the circuit. The current which produced the perforations in the Laure manhole could be of negligible character, compared with the current in any sector, the difference of potential for the public supply varying within the narrow limits of from 90 to 100 volts and 110 to 120 volts. It is easy to explain that this current could have been produced without its existence being revealed by the extinction of lamps or even by a decrease in their brilliancy. We noted also in the gas company's experiments that at the moment when the perforations were produced a voltaic arc followed the short-circuit and played between the cable and the pipe. It was also noted that when in consequence of the fusion and volatilization of the lead the distance became too great for the arc to jump, the phenomenon stopped suddenly and the current was interrupted.

We conclude in the case of the Larue explosion that the short circuit having punctured the pipe in two places the gas immediately escaped and the first jets were evidently lighted by the arc, but the gas was extinguished at the end of a certain time as the supply of oxygen was necessarily limited. We noticed when the experiments made by the gas company with the manhole made like that in the Rue Royal that the gas escaping from the pipe was extinguished at the end of three or four minutes without doubt because of the rarefaction of the oxygen. The gas escaping by reason of the natural pressure filled the manhole and escaped by a hole arranged *ad hoc*. In the case of the Rue Royal manhole the gas passed by the leading pipes surrounding the conductors into the restaurant cellar. It accumulated there and at the end of a certain time—about half an hour—constituted with the air in the cellar a detonating mixture, and, a train being formed through a passage to the Place de la Madeleine, was fired by contact with a gas jet burning outside the restaurant. The capacity of the cellar under the large hall of the restaurant being about 30 cubic yards and the explosive mixture being formed of one volume of gas for eight volumes of air, our calculations have enabled us to estimate, as we have said, that half an hour elapsed between the perforation of the pipe and the explosion.

In regard to the odors noticed in the cellar during the day of the explosion and which did not proceed from the escape of gas as the representatives of the gas company, summoned to the place, had declared, it may be said that they proved that the high tension cables prepared the way for the accident of the evening.

On March 2, 1891, the five small high tension cables in the Larue restaurant certainly became intensely heated. Their coverings were burned, both the lead, caoutchouc and jute wrapping, and the supporting moulding and the zinc screen were destroyed at the same time. This assuredly was the cause of the odor which penetrated into the cellar. The coppper core of the cable remained at a red heat for some time, and there followed an increase in temperature which by expansion caused the displacement of the low tension cables hanging without support in the manhole. The two lowest cables were then thrust into contact with the gas pipe, which they grazed. Then with the commencement of the night service the short-circuit came on.

The experts came finally to the conclusion that the explosion was caused by a short-circuit brought about by the unfortunate presence in the manhole under the sidewalk of a gas pipe crossing a manhole which was designed especially for the electric lighting service of the establishment.

PERFORATION OF GAS PIPES BY ELECTROLYSIS.

Perforations of gas pipes by electrolysis have been extremely frequent in the last few years; they are numbered by the hundreds. The perforations are produced most frequently in lead pipes, though they are met with in the cast iron pipes. While these punctures occur rarely in the three sectors of the Halles Centrales, the Popp company and the Power Transmission company, they have been extremely frequent in the Edison sector. In the sector of La Place Clichy no occurrence of this kind has happened. As the leaks occur upon the public streets the employes of the gas company hasten to the spot and investigate. When the pipes are uncovered holes are at once noted on their surface through which the gas is escaping. It is known that the gas system of Paris under the sidewalks is covered with earth which is of a calcareous character or with plaster coming from buildings that have been torn down, and which, therefore, presents a chemical composition, *i. e.*, carbonates or sulphates of lime. A workman looking for leaks while digging with a pick frequently notices that the ground liberates a certain amount of heat and that the service pipe is affected electrically even up to the meter. At the instant that a loss of electricity occurs in the cable carried under the sidewalk, the current takes the path of the gas system in the vicinity. The carbonates or sulphates of lime, as the case may be, are decomposed by reason of a considerable rise of temperature, and carbonic acid or sulphuric acid is carried to the pipes. When this occurs in calcareous earths it is found that the lead at the edges of the holes is covered with a layer which analysis shows is composed of carbonate of lead and carbonate of lead hydrate mixed with oxide of lead. The carbonate of lead causes thinning of the metal, and finally produces perforation.

When the ground is composed of plaster or sulphates of lime, it is noticed that in consequence of the more immediate action of sulphuric acid the perforated hole is cleaner and presents a crater form. The edges are covered with a brownish powder which analysis proves to be sulphate or sulphuret of lead. These effects of sulphuric acid are noted also in the case of cast iron pipes, even of large diameter, and the periphery of the punctures is covered with a greenish compound which, in accordance with analysis, is ferrous sulphate, ferric sulphate and hydrate of ferric oxide.

These reactions which cause the perforations are due to electricity, and are electrolytic phenomena. The action takes place as if in an electrolytic bath in which one electrode is the gas pipe, the other the cable, and the electrolyte the soil impregnated with water frequently acidulated.

I have said that occurrences of this character have been very frequent in the Edison sector while they were unusual in the other sectors. The Edison company placed its cables in flat boxes with a tile cover (Doulton system). This arrangement seemed to possess every advantage, both because it was air tight and it facilitated inspection. This conduit, built under the sidewalks in earth sufficiently dry and with a slight grade, so that water leaking in could run off, seemed excellent at first. The cables were kept in a good state of preservation and no damage to the neighboring gas pipes was noticed. After a time, however, the joints sealed with cement became displaced under the pressure of the ground. The cement cracked and water entered the conduit. There were then many contacts with the earth at the joints, and consequently losses of current ensued, from which the gas pipes suffered. The Edison company did not hesitate to discard the Doulton system in favor of a cement conduit designed by M. Clerc, one of its engineers, and the system has been employed with success on the boulevards. These conduits, which resemble those used by the Electrical Transmission company, are very small. The work of substitution, which has involved an expense of $80,000, is now completed, and to-day accidents caused by the distributing system are scarcely spoken of.

The gas leaks caused by electrolytic phenomena have up to the present, with one exception, caused no appreciable harm, because of the fact that repairs have been speedily made. The exceptional case I will describe: On the night of June 15th last three explosions occurred in succession in two Edison manholes located in Rue Notre Dame de Lorette, at the corner of Rue Breda. The first occurred at 10:50 P. M. The two manhole covers were thrown into the air, greatly frightening passers-by. One woman was thrown to the ground. The covers were replaced about 11 o'clock, and half an hour later a second explosion occurred, again throwing the covers into the air. Then at 6 o'clock in the morning a third explosion occurred, in consequence of which an immediate investigation was begun. In seeking to account for the occurrence some attributed it to ozone, but finally the following explanation was reached: On the 21st of March it had snowed in Paris, and the street department, in accordance with the usual practice, had used salt in the streets. It was concluded that the salt water had escaped into the Edison conduit. Under the action of the electricity in the cables the salt or sodium chloride had been decomposed into two elements, chlorine and sodium. The sodium combined with the oxygen of the water, and the hydrogen was left in a free state. Then a combination of free hydrogen and free chlorine was formed, making a detonating mixture which had been fired by contact with the electric current and produced the explosion. This explanation was ingenious, and I give it here for what it is worth, but in the explosion in Rue Breda there was certainly no snow to be considered, for it occurred in the month of June. It was doubtless gas which caused the explosion, for when excavations were made it was seen that the pipes had been punctured in proximity to the manholes. The gas escaping from the pipes passed through the Edison tile conduits into the manholes, where three different times it formed with the air an explosive mixture. It follows that to prevent accidents resulting from the proximity of conductors of gas and electricity it is necessary to adopt certain measures.

In 1884 electric lighting and transmission of power had been developed and important installations were decided upon for both Paris and other large cities of France. The administration deemed it wise to interfere to the extent of imposing certain restrictions which would provide for public safety. An administrative and scientific council, presided over by the minister of posts and telegraphs, was appointed for this purpose by the decrees of September 15, 1884, and May 12, 1885. This commission, to which I had the honor to belong, prepared regulations which were approved by decree, rendering mandatory certain precautionary measures relating to the arrangement and operation of electric conductors used for electric lighting and transmission of power.

The decree which regulated the manner of laying conductors, the installation of generative apparatus, the potential of currents, etc., contained no reference to gas except perhaps in article 5, which says: "The use of the earth as a part of the circuit will be permitted only in exceptional cases. The employment of water and gas conduits to complete the circuit is forbidden." On April 16, 1891, six months after the Larue explosion M. Alphand appointed a new commission to investigate means to prevent accidents in the public streets attributed to electricity. As a result of the labors of this commission the prefect of the Seine issued an order dated July 30, 1891, regulating the arrangement of conductors in the following particulars: First, method of insulating electric conductors contained in metallic covering; second, manner of insulating these conductors in relation to other systems which are good conductors of electricity (water, gas, compressed air, etc.); third, absolute prohibition of the practice of placing in a manhole, for the conductors of a given sector, any gas pipe, water pipe, compressed air pipe or similar pipes or any conductor belonging to any other system; fourth, arrangement of the branches and pipes for them in the manholes; fifth, obligation of the holder of a franchise to notify other companies when they encounter the latter's distributing system; sixth, obligation of the company in each sector to examine the electric condition of its system at least once a year. The provisions of this order are enforced under the direction and supervision of the engineers of the municipal service. On their side the companies are not inactive, they are seeking practical solutions of the problem. As I have said, the Edison company has abandoned absolutely the Doulton conduits; and this action entailed a great loss. The Popp company is now engaged in substituting in its cast iron conduits cables supported by paraffined wood mouldings for cables that are often badly insulated. The gas company is investigating a system of isolating its service pipes by laying them in Flemish wooden conduits. It has also attempted to cover the service pipes in these conduits with caoutchouc. On their side the city engineers are laboring to improve the situation. I have no doubt that these efforts will lead to a solution of the problem so that electricity and gas may be distributed side by side in our public streets in perfect safety.

Special Features of the Convention.

According to the programme arranged for the convention, as published in the WESTERN ELECTRICIAN last week, there will be several very attractive features at the St. Louis meeting. Not the least important of these will be the lecture by Prof. Nikola Tesla on Wednesday evening. This address will be delivered at the Exposition building. Another announcement which will be received with interest is the fact that Prof. George Forbes of London will probably attend the convention and deliver a lecture Thursday afternoon. Prof. Forbes is well known to American electrical workers, and he will be accorded a hearty welcome. It is believed that Prof. Forbes' address will be on the subject of utilizing the water power of Niagara.

St. Louis Electric Supply and Construction Companies.

It is but natural that a city of the size of St. Louis should have some interesting concerns engaged in the manufacture, installation and supply of electrical apparatus. The factories of the following named concerns are illustrated in the accompanying cut, together with portraits of representatives of several: The Emerson Electrical Manufacturing company, Rose Electric Light Supply company, Wagner Electric Manufacturing company, Interstate Complete Electrical Construction company. Another feature of national interest which owes its origin to St. Louis is the Chicago & St. Louis electric railway.

ST. LOUIS ELECTRIC SUPPLY AND CONSTRUCTION COMPANIES.

1. Rose Electric Light Supply Co. (P. L. Rose). 2. Schultz Belting Co. (J. A. J. Schultz).
3. Wagner Electric Manufacturing Co. 5. Interstate Complete Electrical Construction Co. (C. P. Lampel, Wm. Murdack). 4. Emerson Electric Manufacturing Co.

SHULTZ BELTING COMPANY.

One of the most thoroughly popular men in St. Louis among those interested in the electrical and allied industries is John A. J. Shultz, president of the Shultz Belting company. Ever since St. Louis began its growth as an electrical center, Mr. Shultz has been identified with almost every scheme that tended to promote the welfare of the local electrical interests. As a prominent member of the St. Louis Electric club and as a man who has lent aid in every possible way to push ahead the work of preparation for the convention, Mr. Shultz is entitled to a full measure of the appreciation of every convention delegate. A short sketch of Mr. Shultz's career and mention of his enterprise in St. Louis cannot fail to be of interest. John A. J. Shultz was born in Grantsville, Md., in 1838, and his experience in the leather trade dates from boyhood, when he commenced work in his father's tannery. He succeeded to his father's business, but sold out in 1864 to come to St. Louis to enter into the hide and leather business. In 1872 he formed a partnership with Capt. C. W. Ford, who was then internal revenue collector, and, it might also be mentioned, a great friend of General Grant. In 1873 Capt. Ford died and Mr Shultz purchased his interest in the tanning business and carried it on until 1876. It was in 1876 that the Shultz belt was first brought out. This article met with such success that in 1877 Mr. Shultz organized the Shultz Belting company. In business and among his personal friends Mr. Shultz is a man much beloved for his sterling qualities, and he is an interesting example of a man who can do good to others and at the same time get out of life a great many of its pleasures. Mr. Shultz is a builder of churches, three such edifices having

been started through his aid; but at the same time, it may be said that he thoroughly enjoys holding the reins over a fast trotter—in fact, it is said that Mr. Shultz is one of the most successful breeders of trotting horses in the country. It will not be necessary to go into the history of the company, for the enterprise, with its capital of $330,000 and authorized capital of $500,000, stands, so to speak, as a monument unto itself. A glimpse, however, of the most important department in the extensive works at the corner of Bismarck and Barton streets is presented in the cut. This view, being of only one department, will give of course but a faint idea of the extent of the Shultz works. The factory proper covers 166 feet by 200 feet and comprises in all three four-story buildings. It is no exaggeration to say that the Shultz company's trade extends all over the world, with the exception perhaps, of China and Egypt. To mention the Shultz factory without a word about Mr. Shultz's most energetic lieutenant would be unfair not only to the man himself but the entire establishment and its founder. Secretary B. C. Alvord has been Mr. Shultz's right-hand man for twelve years, and it is needless to say that as secretary of the Shultz Belting company Mr. Alvord has a right to claim a fair share of the merit that belongs to those who by their united efforts have built up one of the most prosperous of St. Louis' industries.

EMERSON ELECTRIC MANUFACTURING COMPANY.

An industry that was organized by three of St. Louis' brightest young men is shown in view 4. The Emerson Electric Manufacturing company was incorporated in 1890 by J. W. Emerson, C. R. Meston and A. W. Meston. These three gentlemen were respectively the company's president, secretary and treasurer. The concern started in quarters on Elm street, but in 1891 the factory was moved to its present location at 1108, 1110, 1112 St. Charles street. The cut presented herewith shows but a glimpse of the prosperous looking factory that may be visited by the convention delegates. Early in 1892 J. W. Emerson, the company's first president, retired from active connection with the firm, and H. L. Parker, the present president and manager, was elected. Mr. Parker an old railroad man and brought with him an experience well calculated to enable him to handle successfully the flourishing business at the head of which he now stands. The company carries on its business in a thoroughly systematic manner, each man attending particularly to his special department. "The Mestons," as Secretary C. R. Meston and Superintendent A. W. Meston are familiarly called, give special attention to the technical side of the establishment, while President Parker keeps watch upon the general business and financiering of the company. Although President Parker refers to himself as a "business man" pure and simple, his St. Louis friends, and in fact most of the electrical fraternity at large, cannot forget the part he and the Meston brothers played in the preparation of the splendid electrical designs for illuminating St. Louis during last fall's celebration. These splendid ornamental electrical designs received complimentary mention from the electrical press throughout the United States; and even Chicago, with all its boasted originality, condescended to call upon the Emerson company for one of the pieces to be used during the illumination of the city at the time of the World's Fair dedicatory ceremonies.

This device, it will be remembered, was a design representing two flags studded with incandescent lamps, which was exhibited on the Michigan avenue front of the Auditorium, and illustrated at the time in the WESTERN ELECTRICIAN. Credit belongs to St. Louis for this unique decoration. The Emerson company manufactures a variety of electric light and railway supplies. An important branch of its business, too, is the building of alternating current motors. The Meston alternating current fan motor is already well known to alternating central station men throughout the country.

THE WAGNER ELECTRIC MANUFACTURING COMPANY.

This company was organized early in 1891 by Herbert A. Wagner, and at once began to manufacture small fan motors for alternating current. After a prosperous summer's business in this line the company turned its attention to the production of an efficient alternating current power motor and the manufacture of special switch-board apparatus. In July, 1892, the business had grown to such an extent that it became necessary to seek larger quarters, and for this purpose the capital stock was increased to $100,000 and a large factory purchased on Locust street, between Twentieth and Twenty-first streets. Since then the company has been actively engaged in the production of a line of slow speed motors for direct current motors and generators, which are now meeting with great success on the market. The company has just announced that it is now ready to take orders for its new alternating current motors from ½ horse power to 10 horse power. It guarantees these motors for operation on any of the existing alternating current incandescent circuits, and to have an efficiency on both light and full load equal to that of direct current motors of like size. The company's facilities for the manufacture of these motors in large numbers are ample, and a large amount of large and fine machinery is at work turning them out. The officers of the company are: S. M. Dodd, president; James W. Bell, vice-president; S. B. Pilce, secretary and treasurer; Herbert A. Wagner, general manager: Ferd. Schwedtman, superintendent.

INTERSTATE COMPLETE ELECTRIC CONSTRUCTION COMPANY.

The Interstate Complete Electric Construction company was organized in 1890 by Charles P. Lampel, Walter F. Smith and William Murdack, and since the removal of the Heisler Electric company has occupied the old stand on South Seventh street. This concern, in addition to being the general western agent for the Heisler Electric company, is engaged in the electrical construction business, as the name implies. It has a well equipped shop for the manufacture of specialties, particularly those used in connection with electric light and power plants. The officers of this company have had a wide and practical experience in the electrical field, which has well fitted them for the business they have undertaken. William Murdack, president, was identified with the first electric lighting in St. Louis, and prior to the organization of this company was superintendent of the St. Louis Illuminating company for over five years, it being the first incandescent station in St. Louis. Charles P. Lampel, secretary and treasurer, after a careful theoretical training at the Washington University and the Manual Training School, took a practical course in the Heisler factory. While employed by the latter company he installed a number of lighting plants in different sections of the country. Walter F. Smith has been connected with electric lighting since its early days in the East, having had charge of the installation and operation of the largest lighting station in Philadelphia for a number of years, and since then has been genera manager of the Heisler Electric company of Philadelphia.

ROSE ELECTRIC LIGHT SUPPLY COMPANY.

View 1 is a glimpse of the salesroom of the Rose Electric Light Supply company, 1106 Pine street. The bartering of electric light and power apparatus of standard manufacture is rapidly becoming an important branch of the electrical business. The Rose company at the present time is about the only concern in St Louis that makes a specialty of buying, selling and exchanging apparatus that "has seen some usage." A view of the company's St. Louis quarters gives the reader an excellent idea of the appearance of a salesroom that is devoted to the display of a stock that is necessarily of a decidedly varied character. To handle successfully such a business requires an experience of a peculiar nature, and it is just this sort of training that P. L. Rose possesses. At 13 years of age Mr. Rose was a messenger with the Atlantic & Pacific Telegraph company, and two years later he went with the City & Suburban Telegraph & Telephone association of Cincinnati in the same capacity. After two years with the latter company he was appointed telephone inspector for the Bell Telephone company of Missouri. At the age of 19, however, Mr. Rose started the business of building and maintaining private telephone lines, renting his instruments from the Bell company. After two years, though, he bought an interest in the Franklin Electric Works, and this firm's name was shortly changed to the Rose & Rein Electric Works, and a telephone toll system was manufactured. But as this nickel-in-the-slot scheme gave the Pan Electric company an entrance into the business in St. Louis, the Rose company was enjoined by the American Bell company. Shortly after this Mr. Rose severed his connections with Mr. Rein and it was in 1887 that he determined to go in the business of buying and selling second-hand electrical apparatus, and opened an office in the Commercial building, St. Louis. His business grew very rapidly until it was necessary to take larger quarters, and it was at this time that the establishment was moved to its present location, 1106 Pine street. The Rose company, in its Pine street establishment, overhauls all sorts of electric light and power apparatus, making it over so that it is practically as good as new. A large stock of overhauled machines is always kept in the Pine street store-room, but the heavier machines are all stored away in another warehouse in the Mitchell building. Last July the Rose company opened a New York office in the Electrical Exchange building, and it proposes to open a branch establishment in Chicago in the spring.

CHICAGO AND ST. LOUIS ELECTRIC RAILWAY.

The most talked of electrical enterprise—or perhaps the most talked of enterprise of any sort—that has been projected by a resident of St. Louis, is the one now being pushed so energetically by Dr. Wellington Adams. A year or so ago when the daily papers first published items to the effect that a St. Louis physician was preparing to launch a scheme through which the cities of Chicago and St. Louis might be joined by a bee line electric railway, the idea was, to put it plainly, scoffed at. To-day, however, this scheme which, to say the least, was then pronounced by many to be ridiculous, presents an appearance of being one that may be brought to a successful completion. There was no question in the minds of electrical engineers but that trains could be run by electricity at a rate of 100 miles an hour. The skeptics, however, did not believe that the projectors of such a scheme could secure the confidence of capital to an extent that would enable them to carry the novel enterprise to a successful completion. Such, in a few words, was the public sentiment when Dr. Adams organized his company to carry out the project of building the Chicago & St. Louis Electric railroad. Since the work of this company was commenced, various, indeed, have been the comments as to its feasibility and the possibility of the road's successful completion. Like other immense projects, the scheme has had its enemies—this was to have been expected—and there are still many decidedly hostile to it. Whatever may be the final result attained by the Chicago & St. Louis railroad, it is only fair to Dr. Adams, the chief exploiter of the scheme, to say that to all appearances the company is acting in good faith and pushing the work toward completion. Word has just been received from the company to the effect that since work was begun on the road bed October 6, 1892, the progress has been of a most satisfactory nature. The first contract that was let was for the grading through Christian county, but since then a contract for the complete road-bed from Chicago to St. Louis, the

FIG. 2. EDDY ELECTRIC MANUFACTURING COMPANY.

A. D. Newton A. H. Eddy. M. E. Baird.

company states, has been awarded to Bagnell Bros. of St. Louis, and Gravey Bros. of Memphis. The contract calls for standard double track road-bed between the two cities, the track construction to be the same as that of a road for steam motive power; 72 pound steel rails are to be used. The contractors, it is understood, accept one-half of the total payments in first mortgage bonds of the company at par. Its bill before congress, with which the readers of the WESTERN ELECTRICIAN are already familiar, the company feels, has a splendid chance of being passed. The plan for future work is an extensive and conservative one, and as soon as the weather breaks, in the spring, a section of single track 10 miles long is to be equipped and operated. The object of running trains over this comparatively small section of the road is to remove any uncertainty that may be in the minds of the general public, and to demonstrate the feasibility of Dr. Adams' project. The company announces that "The Chicago & St. Louis electric railroad will be built, and trains will be run over it at the rate of 100 miles an hour." Dr. Wellington Adams, the general manager of the company and the projector of the road, is a comparatively young man, being but 38 years of age. His portrait is presented herewith on the left hand side of the cut on page 107. Until a few years ago Mr. Adams was a practising physician. He was, however, an enthusiast on the application of electricity as a motive power for railways, and later on he turned his exclusive attention into what was then a practically unexplored field. Dr. Adams had always maintained that electricity was the ideal power for rapid transit, and his first inventions were along that line. Personally Dr. Adams is a man of a most agreeable temperament; quiet in manner, always courteous and gentlemanly, yet withal dignified and somewhat reserved, he impresses one as well fitted to stand at the helm of such an enterprise as he is now engineering. Intimately connected with Dr. Adams in his management of the Chicago & St. Louis Electric Railway company is Assistant General Manager Charles E. Bleyer. Mr. Bleyer is an old Milwaukeean who took up his residence in St. Louis recently. At the inception of the Chicago & St. Louis Electric railroad project he was approached by Dr. Wellington Adams and asked if he had sufficient confidence in the scheme to manage the Chicago office. After careful investigation Mr. Bleyer consented to connect himself with the enterprise, and now Chicagoans need no introduction to the courteous manager in the World's Fair city. Mr. Bleyer was for a long time a partner of Paul Bechtner in Milwaukee; and he also organized the Commercial club and was its president when the membership touched almost the 1,000 mark. Mr. Bleyer, in addition to his work as an organizer, has, in connection with his brother, S. T. Bleyer, done good work in doing away with Chicago's smoke. The furnace as perfected by Mr. Bleyer stands to-day in the front rank of economical smoke consumers. Through that energy and push so characteristic of those who have done well in the World's Fair city, backed by his dignified and courteous bearing toward those with whom he transacts business, Mr. Bleyer makes many friends, and it is generally agreed that Dr. Adams made a wise choice in his selection of Mr. Bleyer to be manager of the Chicago end of his enterprise.

Eddy Electric Manufacturing Company, Windsor, Conn.

The spirit of consolidation which has developed so much strength in the electrical field during the last few years and which has effected so many changes in the relations of old rivals has not succeeded in combining all the big companies under one management. Several of the old concerns have preferred to retain their individuality, if the term may be used, and many of these have extended the field of their operations. Prominent among the companies which preferred to continue under the old order is the Eddy Electric Manufacturing company of Windsor, Conn. This company, within the last year, doubled the capacity of its factory, and now it finds the present quarters crowded to such an extent that further additions are under consideration. This is in keeping with the natural growth of the business. The Eddy company is the outgrowth of the business established in 1881 by A. H. Eddy, the present head of the company. At that time Mr. Eddy opened a small shop on Market street, Hartford, and engaged in dynamo building. He had had valuable experience in mechanical work, having served an apprenticeship in the works of the Harris-Corliss Engine company, Providence. His first efforts in the electrical field were directed in the line of building dynamos for electroplating. In this he succeeded admirably the business increased rapidly, and in October, 1885, the present company was formed to continue the business on a larger scale. In 1885 the business had increased very largely, and in October of that year the present company was organized. New quarters were taken at 42 Union place, and in addition to the plating machines the manufacture of motors and generators was taken up. After two years of prosperous business it was found necessary to have increased facilities, and a site was purchased at Windsor and a factory erected. The original building had a frontage of 145 feet and a depth of 50 feet, but even this space was found to be inadequate, and last spring another building was added, giving a total frontage of 300 feet. This is the building shown in the cut. There are several smaller buildings connected with the plant, all of which are occupied.

The company's factory is a substantial brick structure, 300 feet long and 50 feet deep. A view of the exterior and several glimpses of the interior are presented in the cut, Fig. 1. This building is on the line of the N. Y., N. H. & H. R. R. company and within easy access of Hartford. This company is thus afforded excellent facilities for shipment. The general offices occupy one end of the ground floor of the main building at present, but they will soon be removed to a separate building especially constructed for this purpose.

On the ground floor is the power plant, including two engines, the largest of which is a 250 horse power tan-

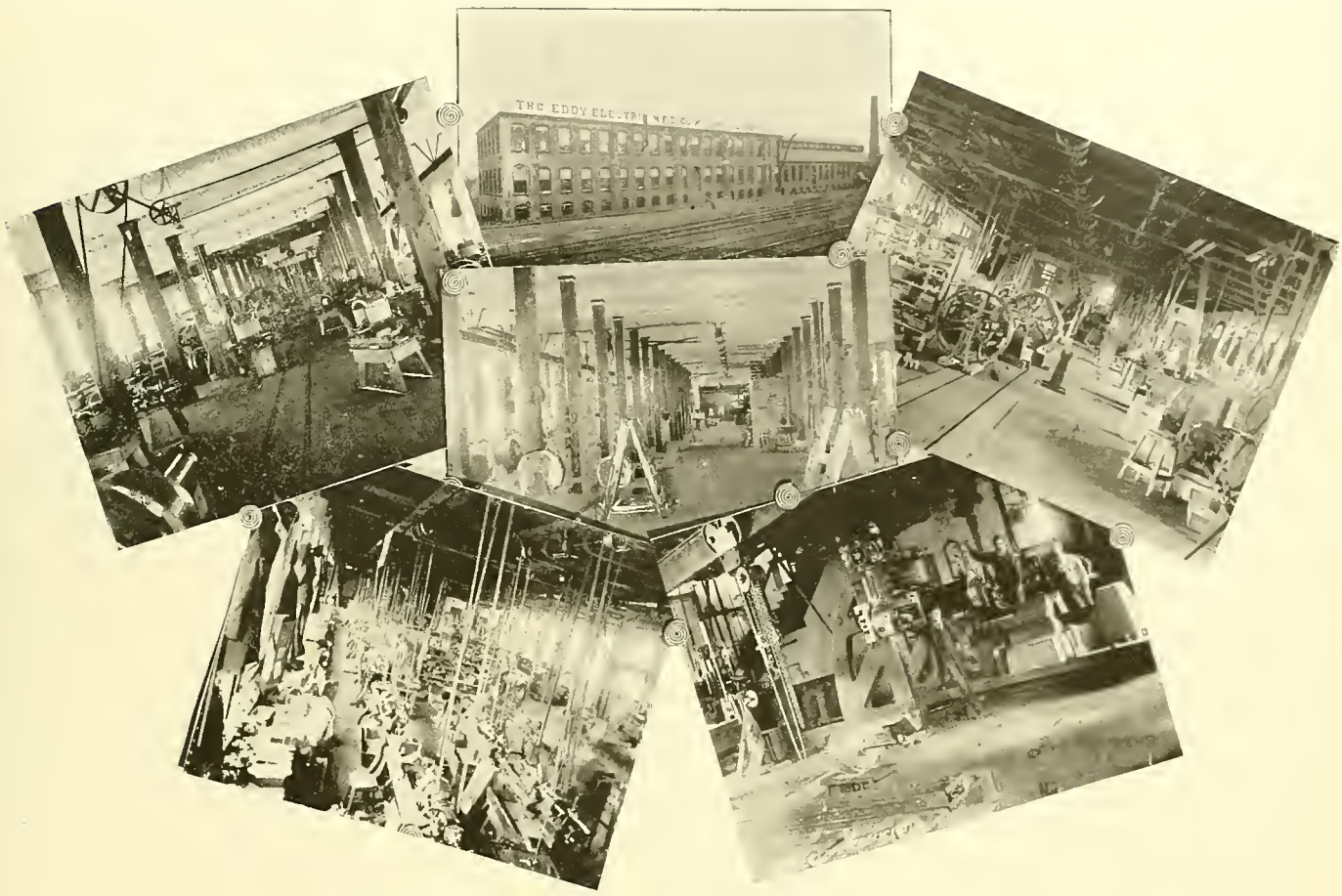


FIG. 1. EDDY ELECTRIC MANUFACTURING COMPANY—GLIMPSES OF THE FACTORY.

dem compound of the Ball type. Adjoining is the boiler room containing a 250 horse power Roberts boiler fed by fuel oil. A small engine is used for forcing the draught, and one of the company's motors is used in addition when testing the large generators. At such times nearly 300 horse power is needed. Four 25 horse power machines are used for lighting and power purposes, and two additional machines of 100 horse power each are now being built.

The balance of the ground floor is occupied by the buffing and polishing room, the armature department and the shafting and commutator departments. Here are to be seen some valuable special tools, including an automatic screw machine. This is used for making a number of articles, such as binding posts, studs and bolts.

The central figure of interest in the machine shop is the apparatus for planing heavy castings. There are two massive planers, one weighing 24 tons. It has a 14 foot bed and a planing surface of 60 by 60 inches. The other has a capacity of 42 by 48 inches and a 12 foot bed. Both of them are in use day and night, and at present are employed on castings of the four 250 horse power six-pole generators which the Eddy company is making to furnish power at the World's Fair. These machines when completed will weigh twelve tons. Between the two planers is a Warren radial drill with a six foot arm, used for drilling the heavy castings, and in the rear of this is a boring mill made especially for boring out the field magnets

of the smaller sizes of machines. It has a sweep of 26 inches in the clear. There is also a 36 inch automatic gear cutting machine, and many other special devices are employed in this department. There are at least thirty different styles of machines used here, each serving some special purpose. The winding department for large armatures which are too heavy to be carried to the floor above is on this floor, and there is also a tool room. The balance of this floor is devoted to the testing and assembling departments. The testing department has a capacity for thirty machines, and here can be seen all the various sizes, ranging from one-half to 100 horse power in two-pole, and up to 180 horse power in multipolar machines. Among the interesting objects shownon this floor are two transformers of 50 horse power each and one 100 horse power alternator ready for shipment to the Electric Forging company of Boston. In a test of one of these transformers in

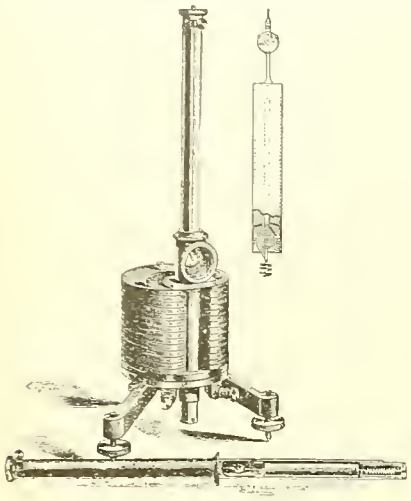


FIG. 1. NEW MEASURING INSTRUMENTS OF PRECISION.

connection with a 50 horse power machine, a bar of iron one and one-half inches in diameter was brought to a white heat in less than thirty seconds.

On the upper floor is the spool winding department, the soldering and insulating room, armature winding department, drying ovens and store rooms. Here also is the instrument room, a very important feature, used for calibrating and recording resistances of the machines while being tested. Wires run from here to the testing department, and a complete record of each machine while under full load is kept and filed for future reference.

Above the general offices on the ground floor is the draughting room, the office of the electrical engineer and the speed indicator department.

The pattern shop and blacksmith shop occupy two separate buildings in the rear of the main structure, the former being 25 by 72 feet, three stories in height, and containing the necessary machinery for woodworking of all descriptions. The blacksmith shop is also of brick, 30 by 50 feet, and one story high.

The entire plant is heated by air forced over steam pipes and distributed to all parts of the building, and lighted by both arc and incandescent lights. There are 600 of the latter and a large number of Waterhouse arcs run two in series on incandescent circuits.

Two Morse elevators with automatic hatch devices furnish easy access to the several floors, and a railroad track runs the entire length of the shop, on which the heavy castings, some of which weigh six tons, are moved.

The factory stands within fifty feet of the main line of the N. Y., N. H. & H. R. R., and a siding runs directly to the door of the shipping department, so that the facilities in this respect are unsurpassed.

The present officers of the company are: President, A. H. Eddy; secretary and treasurer, A. D. Newton; general agent, M. E. Baird; superintendent, George T. Briggs; electrical engineer, H. S. Rodgers. The management of the business is under the personal supervision of Mr. Newton. Following are brief sketches of Messrs. Eddy, Baird and Newton, whose portraits are presented in Fig. 2:

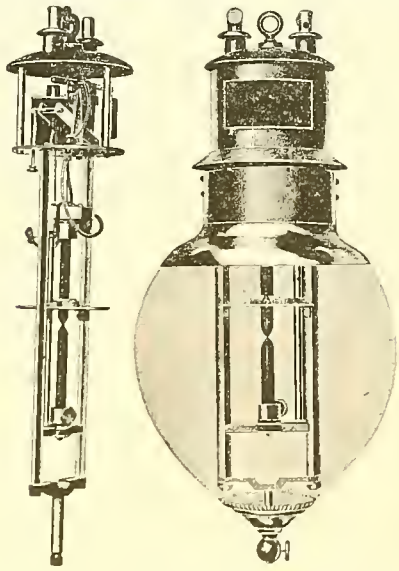
A. H. Eddy started his business career by taking a course at the Polytechnic school at Troy, N. Y., after which he entered the Corliss Engine Company's works at Providence, R. I. He was in the heavy machinery department two years, and then took up the lighter class of work for the two years following. He then went to Hartford, Conn., entering the Weed Manufacturing company, now more familiarly known as the Pope Manufacturing company, when the bicycle works first started. He took up the work of the telephone and later accepted an offer from Marshall Jewell in 1879 as general manager of the Southern New England Telephone company. In 1880 he was a short time connected with R. H. Mather in bringing out a new plating machine and later started out for himself in the manufacture of these machines, building about 160, all of which are in use to-day. On October 1, 1885, the Eddy Electric Manufacturing company was incorporated.

M. E. Baird's first business experience was gained with Holmes, Booth & Haydens in Boston, being connected with that concern for three years. He then went to Philadelphia, where he remained two years with the same company, after which he accepted the position of general traveling agent for that concern, with headquarters at Waterbury, Conn. He retained this position five years, when he entered the Eddy Electric Manufacturing companys as general agent for the company.

A. D. Newton, after receiving his education at the public school, of Hartford, entered a large wholesale dry goods house in his native city, where he remained for three years. He then became associated with A. H. Eddy, who was engaged in the manufacture of machines for electroplating, and upon the organization of the Eddy Electric Manufacturing company he became its secretary and treasurer, a position which he has filled with great credit to himself. He is largely responsible for the prosperous and large growth of this well known company.

Helios Alternating Current Arc Lamp.

The Helios arc lamp is the invention of Carl Coerper of Ehrenfeld, Germany. With some minor improvements it is controlled in America by the Helios Electric company of Philadelphia Fig. 1 shows the lamp with globe and cap removed. The construction and operation involve the most simple mechanism. As will be seen, the lower carbon holder is attached to a chain which is carried over a pulley in the lamp mechanism, the other end being attached to the upper carbon holder. The result of this arrangement is that, as the lower carbon ascends, the upper carbon descends, and exactly in the same ratio. The arc is thus fixed at a given point and remains stationary from the time the current is turned on until the carbons are consumed. As is well known, the alternating arc forms a crater both in the upper and lower carbon, so that consid-



FIGS. 1 AND 2. HELIOS ALTERNATING CURRENT ARC LAMP.

erable light is emitted by the crater of the lower carbon, which is thrown upward and thus generally wasted. This has been overcome by placing, about one-half an inch above the arc, a white enameled reflector, which throws down all the light emitted from the lower carbon. The regulation is effected entirely by a single solenoid coil, the feed of the carbon being controlled by a lever which presses against the periphery of a friction wheel included in the releasing train. Fig. 2 shows the 7-hour lamp complete, with globe, ready for use. The length of the 7-hour lamp is 25½ inches over all; the 12-hour lamp, 32 inches. The single carbon principle is used exclusively. In Europe it is said that over 30,000 of these lamps are in daily use.

Crompton & Co., the English electrical manufacturers, possess an "electrical dog," a little fox terrier known as "Strip," that has achieved renown by passing through conduits, carrying the drawing-in cord. It is said that this dog has helped to lay many miles of cable in London and other English cities.

New Measuring Instruments of Precision.

Queen & Co., of Philadelphia, have recently put upon the market some electrical measuring instruments original in design and efficient in use. Fig. 1 shows their new form of D'Arsonval galvanometer. The magnet is horizontal, circular in form and built up of a number of disks stamped from sheet steel. The pole faces are shaped so as to give readings on a straight scale exactly proportional to the currents measured. The coil is long, narrow and circular in cross-section, and is fastened in an aluminum tube which forms part of the movable system. No iron core is used. The suspension tube is fitted with a movable bottom, which, when raised, lifts the coil so as to relieve the suspension, and clamps it tight. This prevents

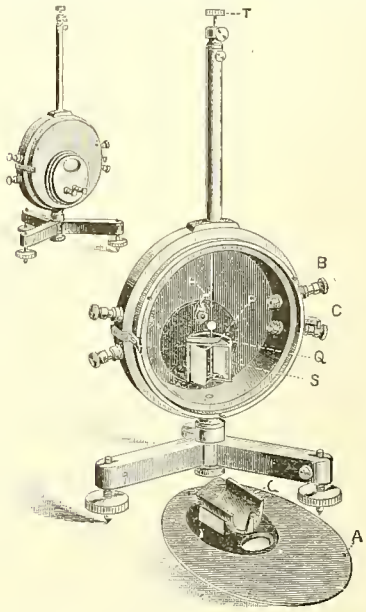


FIG. 2. NEW MEASURING INSTRUMENTS OF PRECISION.

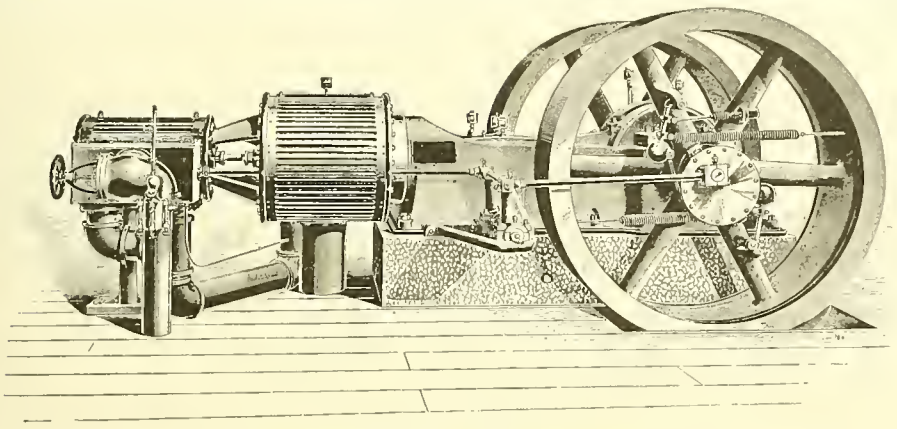
any injury during transportation. The whole suspension tube can be lifted out and replaced by another, automatic sliding contacts being made as the tube is put in position. To use the instrument all that is necessary is to lower the bottom gently and relieve the coil. The mirror is so arranged that the axis of rotation lies in the center of the reflecting plane and the mirror window; the cage is tilted to prevent reflection from its surface. The instrument is sensitive to a high degree, and being uninfluenced by strong and varying fields, or mechanical vibrations, gives as accurate results when used in a dynamo room as when used on a brick pier in a laboratory. It therefore extends the range of usefulness of a highly sensitive galvanometer beyond anything yet reached. For general use the motion is made dead beat, so as to obviate the necessity of using "tapper keys," thus saving time, which is important when rapid and exact work are demanded. Tubes are also made for ballistic work in which the damping effect is lessened, and in this connection a bifilar suspension has been used. When used as a ballistic galvanometer, the coil on being thrown to the end of the scale may be brought completely to rest in from 12 to 15 seconds by merely short-circuiting. The instrument can also be used for thermal work. It is claimed to be second in sensibility only to a high grade Thomson galvanometer, and second to none in being uninfluenced by varying external fields or mechanical vibrations.

Fig. 2 represents the Ryan electrometer. This instrument was designed by Prof. Harris J. Ryan, of Cornell University, for measuring potential difference, either direct or alternating. The quadrants, four in number, are mounted on two quartz disks, set on the inside of two metal covered plates that protect the system, and are faced with mica to prevent short-circuiting should the needle happen to touch them. The needle is cylindrical in shape and can be hung with either quartz or silk suspension. It is situated exactly in the center of the cover case, and just above it is fastened the mirror whose silvered surface contains the axis of rotation. The cover case is made of two parts symmetrically disposed with respect to the system, and held in position by a spring clip. In this way both parts, each carrying a pair of quadrants, can be lifted from the frame so that the needle may be inspected. Three little pegs, over which half of the cover plate fits, insure their returning to the same relative position. Opposite quadrants are rigidly connected by metal strips, the two pairs being connected to binding posts on the outside of the cover case. A binding post, also on the outside of the

cover case, connects with a hook on the inside, from which a connection is made with the needle by a platinum wire .0002 inch in diameter. On the circumference of the cover case, and symmetrically disposed with respect to the system, are two wound coils, one of coarse and the other of fine wire. These enable the instruments to be used in two ways. Either the electromotive force may be calculated from the deflection it produces, this being measured by a scale and telescope, or else a zero method may be used, in which the needle is brought back to zero, after being deflected by the action of a current passed through the wound coils mentioned above, and the electromotive force calculated from the magnitude of this current. This latter has the advantage of giving results unaffected by changes in the earth's field. The instrument can be used with equal success on direct and alternating circuits, as the instrument takes no current and has no induction to be corrected for. It takes up little room, is strong in make, and recommends itself as much for commercial as for laboratory work.

A 400 Horse Power Tandem Compound Engine.

In this engine, which is especially adapted for driving street railway generators, the stroke is made short for the purpose of raising the number of revolutions and reducing the wheel diameters so as to more nearly approach the diameters of the generator pulleys, giving better belt contact. The range of wheel diameters is from 80 to 112 inches, which enables the engine to drive directly on to the pulley of the different makes of generators without the interven-



A 400 HORSE POWER TANDEM COMPOUND ENGINE.

tion of line shafts or other devices for raising the lineal velocity of the belts, this being accomplished within economical ranges of piston speed (600 to 700 feet per minute) and perfectly reasonable as well as economical steam pressures (100 to 115 pounds). The engine herewith illustrated is one of several which have been put in operation within the last year. It is well balanced and does not require the large foundation which its slow speed competitor is obliged to have, one of them giving satisfactory results at a speed of 210 revolutions on a pier of its own length, 17 feet high. This engine is endowed with unusual strength and rigidity, owing to the form of the frame, shaft, cylinders, heads and reciprocating parts, the latter, with the exception of the pistons and wrist pin boxes, being of forged steel from tip to tip. The shaft is of forged steel. The high pressure valve motion is derived from the governor, while the low pressure valve is driven by direct connection from an eccentric on the other side of the engine, this eccentric being adjustable for the purpose of making a more perfect adaptation of the engine to its load when the actual running conditions are demonstrated. The valves, of the "nearly" balanced type, are steam tight and will remain so indefinitely, as the wear is so trifling that a few hours of scraping will renew the faces as good as when first started, after two or three years' run of 10 to 18 hours per day.

The engine shown in the illustration has 18 inch high pressure and 30 inch low pressure cylinders, with 18 inch stroke of pistons, and carries two wheels of 96 inch diameter by 25 inch face, weighing 10,000 pounds each, giving a flywheel capacity and efficiency equivalent to more than double their weight if made into a 20 inch wheel for a 60 inch stroke engine, working under one-third as many revolutions. It is claimed for this plant that with a regulation giving an increase of speed of 1 per cent. from empty generators to full capacity (850 kilowatts), the voltage taken at 480 when no current is being used will follow the increase of engine speed almost exactly up to the maximum of 500 for full load. This type of engine is manufactured by the Ball Engine company of Erie, Pa.

CORRESPONDENCE.

New York Notes.

NEW YORK, February 25.—The State Board of Trade is commended by the daily papers of this city for urging upon the legislature the need of regulating telephone charges. In a report adopted at Albany last week the board says:

It is notorious that the charges for telephone service in this state, and especially in the city of New York, are higher than those made for like service anywhere else in the world. In all the more important cities of South America telephone service is rendered on a metallic circuit with the wires under ground and with the best instruments (plant and instruments made in and furnished from the United States) at a charge of from $25 to $35 per year. The strong presumption therefore is that a charge of $240 in the city of New York is excessive; that a charge of over $100 in Buffalo is disproportionate to the legitimate demands of the investment, and that there exists every reason for such legislative enactment as will not only discover the facts but regulate the charges within reasonable bounds.

It is contended by the advocates of this measure that the Legislature has power to regulate rates of service, and it is generally agreed that if such power exists it should be exercised in this case. It was on the rates charged by the company in New York's principal cities that led to the introduction of the bill, noted in last week's letter, providing for the establishment of a telephone commission to regulate such matters. While the bill providing for a state commission is not generally commended, it is believed that some measure will be passed which will afford the people an opportunity to air their grievances. Concerning the management of the company, the Board of Trade remarks that "there is no sound theory of public policy that will permit the companies enjoying the monopoly of the business to so handle it as to reduce business while enhancing profits, and by so doing to deprive any man or woman of its use who wishes to use it and can pay for its use a reasonable but remunerative rate to the owners." W. F. O.

New England Notes.

BOSTON, MASS., February 18.—The Manet street railway of Quincy, Mass., has been bought by the Quincy & Boston Street Railway company. The road is four miles long and is operated by electricity. Its principal use is to connect the summer resorts of Hough's Neck and Manet Beach with the city of Quincy.

The Marlboro, Mass., street railway has been sold to S. H. Howe by the executor of the Samuel Boyd estate which owned it

The State Central Street Railway company of Worcester has gained its first victory in its attempt to control the street railways of the central portion of Massachusetts. It is having a general contest with the Worcester & Shrewsbury Street Railway company after franchises in the towns near Worcester. Both applied for the right to lay tracks in the town of Westboro, and on February 20th the selectmen of that town granted the franchise to the State Central. Similar petitions are to be acted on in Shrewsbury, Northboro and Marlboro, and the first victory is supposed to foreshadow the final result in all these places.

The General Electric company has secured a contract to equip an electric tramway in the coal yards of Joseph Bowen of Fall River. There will be one 4 ton electric locomotive which will be used to draw coal from the vessels to the bins on the dock.

The Thomson Electric Welding company of Lynn is said to have bought all rights to a new electric loom which it is believed will revolutionize present methods of weaving. C. E.

PERSONAL

Daniel Hemingray of Covington, Ky., was in Chicago last week.

F. P. Little of Buffalo, N. Y., made a short visit to Chicago last week.

C. J. Swift, business manager of the Ford-Washburn Storeelectro company, Cleveland, O., was in Chicago last week.

G. A. Redman, superintendent of the Gas & Electric Light company, Rochester, N. Y., was in Chicago last Saturday en route for the convention at St. Louis.

NEW INCORPORATIONS.

Rochester Fire Alarm & Signal company, Rochester, N. Y.; capital stock, $30,000; to manufacture and sell fire alarm systems, electric signaling, etc.

Chester Light, Water & Ice company, Menard, Ill.; capital stock, $35,000; to operate electric, gas, water and ice plant; John D. Gerlach, Chester, Ill.

Jefferson Light, Heat, Power & Water company, Jefferson, Ia.; capital stock, $50,000; to manufacture fuel, gas, electric light, etc.; Church & Lovejoy, Jefferson, Ia.

Canadian Whitney-Hoyt Electric company, Portland, Me.; capital stock, $50,000; to manufacture and deal in all kinds of electrical machinery; C. A. Hight, Portland, Me.

Beers Electrical Fan & Motor company, Newark, N. J.; capital stock, $100,000; to manufacture electrical fans, motors, etc.; John M. Knapp, 19 Park place, New York, N. Y.

Dayton, Germantown & Middletown Electric Railway company, Dayton, O.; capital stock, $10,000; constructing and operating an electric railroad between Dayton and Middletown, O.; Albert E. Boone, Dayton, O.

Allen-Maxwell Manufacturing company, Chicago, Ill.; capital stock, $300,000; to manufacture and sell chilled gear wheels, electric supplies and general foundry business; J. Edwards Fay, Commercial Bank building, Chicago, Ill.

Puget Sound Investment & Improvement company, Seattle, Wash.; capital stock, $250,000; to deal in bonds, notes, stocks, etc.; build, own, equip, sell or operate railroads, tramways, street cars, steam, gas and electric light plants, etc.; George H. Heilbroun, Seattle, Wash.

ELECTRIC LIGHTING.

The town of Dalton, O., contemplates putting in an electric light plant.

The Dixon, Ill., Power & Lighting company has increased its capital stock from $25,000 to $100,000.

The stockholders of the Colchester, Ill., Electric Light & Power company will meet February 23d to consider a proposition to increase the capital stock.

Queen Victoria, says a society note, is not a great admirer of the electric light. Last year, yielding to the persistent entreaties of the Princess Beatrice, she consented to have the royal yacht fitted up with the electric light. Only one stipulation was insisted upon, and that was that the light should not invade the saloon or her private cabin. The same influence, under the same restrictions, has at length triumphed at Osborne. The Indian room is this month, for the first time, lighted with electricity, the electric light also flashing in the principal corridors. But the queen will have none of it in her own apartments, or in the larger common rooms she frequents.

The new regulations issued by the municipality of Paris, governing the laying of wires of private electric companies, entirely prohibit the placing of such wires in sewers or other underground conduits located between the curbs, and demand the laying of such wires under the sidewalks. The materials used in the conduits must be approved by the proper municipal officers, who are also to specify the position, exterior diameter and required depth of the conduits. The most favorable positions, near the surface of the streets, are reserved for the municipal electric light conduits. In order to avoid crossing streets to make house connections, a conduit must be carried under the sidewalk on both sides of the street except in very narrow streets. Whenever a conduit crosses a street it is to be made accessible by a manhole on one side. In very important thoroughfares each side must be furnished with a manhole. If several companies are laying wires in the same street, a common conduit must be employed, the accruing costs to be shared equally between them. Electric wires of private companies are not to be carried closer than 3.28 feet to the front walls of houses, which space is to be reserved for the laying of municipal wires. The connections are to be carried in conduits of smaller diameter to the limits of the house. Other branches from the conduits and transformers are to be placed outside the street. The application for a permit for laying electric wires must be accompanied by detailed plans, for the preparation of which the municipal records and plans of sewers, water conduits, etc., may be consulted. The general plan, drawn to a scale of 1-1000, must show the proposed conduits, with house connections and the number of lamps. The amount of power to be supplied, the position and material of the cables, and the size and material of the proposed conduits must be specified.

TELEGRAPH.

An amateur electric telegraph company exists in Buffalo that is known as the West Side Private Telegraph company. Private telegraph operating is carried on quite extensively in Buffalo. The three largest lines in the city are the Union, the Queen City and West Side, the last named being the largest of the three, having a membership of over

thirty, and operating over fifteen miles of wire. The line is more for pleasure than business. The constitution of the company limits the membership to fifty persons. An initiation fee of one dollar is charged, but after forty members have been secured the fee will be raised to five dollars. The dues are $25 a month and the fund thus raised is used to purchase material.

A St. Paul dispatch states that there is much discontent among the Western Union operators in that city. On Wednesday of last week ten men were discharged, but no reason was given for their summary dismissal. Inquiry at the central office revealed the fact that Superintendent McMichael ordered the men discharged and left at once for a trip to Sioux City. Among these men are several who have been in the employment of the company for from ten to twenty-five years, some of whom have large families. The supposition is that he men discharged are believed by the company to belong to the Order of Commercial Telegraphers. Not more than half of the operators discharged, however, were members of this order.

TRADE NEWS.

Handsomely illustrated catalogues describing the Stanley transformer are being furnished the western trade by the Ansonia Electric company, which has the western agency for this device,

The Electric Appliance company, Chicago, has taken the western agency for the "O. K." weather-proof, house, line and feeder wires, and will carry a large and complete stock in Chicago.

W. B. Roberts, general manager of the Rockford Electric Manufacturing company, was in Chicago last week. Mr. Roberts had been in Milwaukee a couple of days starting some new installations there.

The contract for the electric work in ex-Governor Cooper's new ten story block in Denver, Colo., has been awarded to the Russell & Officer Electric Construction company of that city, which will install the Brush Electric company's apparatus and 250 Russell automatic switches. The Russell & Officer Electric Construction company has the agency for the Brush apparatus in Denver.

The new motor of the General Electric company will be of 20 horse power and will weigh 1,250 pounds. It is intended to take the place of the old 15 horse power machine which weighed about a ton. The company is preparing also to put on the market a new narrow gauge electric railway motor designed especially for tramway work. It will have a capacity of from 4 to 8 horse power, and can be used on as narrow a track as eighteen inches.

The Delaware Hard Fibre company of Wilmington, Del., is sending to the electrical trade a very neat catalogue in which it shows a number of different devices to which hard fibre is applicable in electrical work, among which are switch handles, brush holders, fuse blocks, etc. An interesting feature of this material is that it improves with age, and fibre that has been cured six months or a year gives excellent results in electrical work. The hard fibre made by this company is a vegetable substance. It is unaffected by contact with alcohol, turpentine, ammonia or any of the vegetable or mineral oils. This company is rushed at present with orders for these goods to be used in electrical work.

The Goulds Manufacturing company of Seneca Falls, N. Y., reports the installation of many electric pumps. Probably one of the largest plants of this character is the one that will be installed at the water works of the city of San Antonio, Texas. This plant consists of three 10 by 13 inch triplex power pumps, each operated by a 30 horse power C. & C. motor, the combined capacity being 3,000,000 gallons per 24 hours. The water is taken from four artesian wells 8 inches in diameter and 2,500 feet deep; the combined capacity of these wells being 4,000,000 gallons per day. From the pumps the water is discharged through a 22 inch main into a reservoir situated three miles distant, and to a vertical height of 165 feet above the pumps. At present the electric power is generated in the local power station of the town, but ultimately the current will be generated by means of water wheels situated three miles distant from the pumping station. The motors are geared direct to the pumps and are arranged with such automatic devices as necessary to run the machinery at any desired speed to meet the varying requirements of the city's supply.

With the assent of 99 per cent. of the stock and bondholders of the Electric Secret Service company all of the property, patents, business and good will of that concern were sold by C. P. MacKie, receiver, on February 11th to the Electric Selector & Signal company. This new corporation has acquired important inventions relating to the subject of electrical selection, and proposes to develop this business as applied to telegraphs, block signals, electric light and power and telephones in this country and abroad, on a larger scale than the company which it succeeds. The change has been effected without interruption of the business of the Electric Secret Service company, and upon terms which provide for a settlement of all of the old company's obligations in full in cash. The Electric Selector & Signal company will retain the technical experts of the Electric Secret Service company, although its board of directors will contain several new and influential names. The company will have an exhibit at the St. Louis convention, consisting of the company's system of selective and light and motor cut-outs. Some new devices have lately been added to the system which materially simplify the operation of the cut outs; these will be shown for the first time at the convention. The company will be represented at St. Louis by C. P. MacKie, Robb MacKie, S. S. Bogart and Herbert Laws Webb.

BUSINESS.

The Central Electric company of Chicago is putting on the market a porcelain socket without a screw, excepting the necessary binding screw. All the parts are well made and it is especially recommended to construction men on account of its simplicity in wiring. Both wires can be cleaned an equal distance from the cord knot, thus insuring the socket hanging plumb.

The power station being built by the Calumet Electric Street Railway company, Chicago, Ill., is approaching completion. The engines to be used are four 300 horse power cross compound, manufactured by the Ball Engine company, Erie, Pa. The new Frank Jones building, at Cincinnati, will be furnished with power for electric lighting by an engine furnished by the Ball company.

The St. Louis office of the General Electric company as now organized is in a most excellent condition to do good work. W. L. Arnold is in charge of all central station and isolated work of that territory; George D. Rosenthal is at the head of the supply and mining department and Frederick E. Allen directs the railway department. With headquarters now permanently located in the Wainwright building, rooms 810–811, and with three such bright, energetic men at the helm, the prospects for a rapid increase in the already good business of the General Electric company in this district cannot be otherwise than most excellent.

The electric elevator installed by Sprague, Duncan & Hutchinson, consulting electrical engineers, New York, in the Grand Hotel on 31st street and Broadway, seems to be quite an attractive feature of that hostelry, and in fact, F. Theodore Walton, of Philadelphia, who recently bought the lease and good will of the Grand, considers the elevator the most attractive feature about the place. Mr. Walton says that this elevator can "get to the top quicker than any other in the country." Visitors to the Grand who are fortunate enough to be shown through by the new proprietor are always shown the "wonderful" electric high speed elevator.

The swinging ball lightning arrester for which the Electric Appliance company, Chicago, has the general western agency is in great demand. The company has put in a large stock for this season. This company reports that business is already beginning to open up on the Meston alternating current fan motor, and that it has already closed a number of agency arrangements and entered some very large orders for fan motors. The Meston motor is well known, and it is the intention of the Electric Appliance company to have a good live agency thoroughly established in every large town having an alternating plant before the fan season opens.

The Acme Filter company, 714 North Main street, St. Louis, Mo., is pushing its device for cleansing "drip" of dirty oil among central and isolated stations. It is now nearly two years since this filter was first placed on the market, and the 500 now in successful operation in about thirty states, territories and in Mexico may be taken as a good illustration of the manner in which practical men appreciate this apparatus. A perusal of the letters received from the users of this filter convinces one that it is looked upon as a dividend increaser. The Acme Filter company courts investigation of the merits of its filter, as it believes it to be one of the most practical and easily operated devices of its kind on the market. The Chicago agents of this filter are Taylor, Goodhue & Ames.

The Ford-Washburn Storelectro company, of Cleveland, O., has just received an order from the Woodland company and West Side Street Railway company for five 30-horse power street railway motors. These motors are to be of the company's new slow speed, single geared type, with the new flexible connections. This improvement in the method of connecting the armature shaft to the gearing has the effect of lessening the wear on the gears to a very appreciable extent. The Ford-Washburn company lays great stress on the value of this shaft coupling and invites a thorough inspection of its merits. It should be mentioned, also, that the company has just received a large order for storage batteries from Calcutta, India. The cells in this case are to be used for train lighting.

That rawhide belting is in favor in Chicago, as well as elsewhere, will be appreciated after a perusal of the Chicago Rawhide Manufacturing company's list of establishments furnished. Among the plants operating rawhide belting may be mentioned the Rookery, the Palmer House, Potter Palmer's residence, the First National Bank, the Chamber of Commerce, etc. In the Rookery 150 to 500 horse power is transmitted by a seven-eighth inch rope that has been in service for three years. Wanamaker in Philadelphia is also an extensive purchaser of this company's rawhide belting, and that firm, it may be mentioned, is one of the staunchest advocates of its use, claiming that the adoption of rawhide belting has saved through its lessening frictional losses at bearings, etc., as much as $150 per year. Wanamaker, however, is but one of many that testify in favor of rawhide.

A new electrical telephone is to be manufactured in Chicago by the D'Unger Electrical Telephone Manufacturing company, with offices at 167 Dearborn street. These instruments, it is claimed, are vastly superior to the ones now in general use, being much simpler and less liable to get out of order. They will be sold outright to the consumer, and will be handled by the electrical trade generally. This company is to manufacture only for the private line use, and it is estimated that a very great demand will be created as soon as the trade and the public know they can be had without rental. The company agrees to protect all instruments sold, which are manufactured under the several patents issued by R. D'Unger in 1888, '89 and '92, and in no wise do they conflict with any of the present telephones in use. It is a common mistake to assume that the Bell instrument as now built, can be manufactured by any one. This cannot be done, nor for several years to come, therefore it behooves the dealer to handle only such instruments as do not conflict with that. The D'Unger instruments have been thoroughly tested during the last four year swith the best results. The trade should bear this in mind, and any information desired as to prices and terms will be gradly given by the manufacturers.

The Turbayne-Tamblyn company of Detroit, Mich., successor to Liggett, Turbayne & Co., has lately moved into its new factory and is now rapidly filling orders for the Turbayne arc lamps. This company is now fully equipped with new machinery and will shortly place on the market a number of specialties for use in central stations. The company will also put on the market during the coming summer season alternating and direct current fan motors. The Turbayne arc lamp has now passed the experimental stage, and the company feels that it has been brought up to a standard that will enable it to compete successfully with any lamp in the market. An order has been received for the city lamps of Milford, Mich., and one also from the Steel Spring Works, Detroit. A notable event in the life of this company should be recorded. The local Brotherhood of Electrical Workers and Trimmers recently petitioned the Detroit city council, asking that the Turbayne automatic mast arm cut-out be included in the specifications of the city lighting contract. The petition met with the favor of the council and the clause was inserted as desired. William A. Turbayne is electrician of the company, Charles Tamblyn general manager, and Joseph F. King is assistant manager. The Electric Appliance company, Chicago is the company's western agent.

ELECTRICAL PATENTS.

Issued February 21, 1893.

491,988. Electric Railway Trolley. Alfred Dickinson, Darlaston, Eng.

491,990. Multipolar Dynamo Electric Machine Armature. George E. Dorman, Chicago, Ill.

491,992. Cut Out for Incandescent Electric Lamps. Thomas A. Edison, Llewellyn Park, N. J.

492,008. Pole Standard for Arc Lamps. Frederick D'A. Goold, Scheneetady, N. Y.

492,011. Electrical Indicator. Henry J. Haight, New York, N. Y.

492,019. Magneto Telephone Switch. William Humans, Cambridge, Mass.

492,036. Automatic Circuit Breaker for Motors. Robert T. Lozier, New York, N. Y.

492,106. Conduit Railway. Frank B. Rae, Detroit, Mich.

492,124. Duplex Electric Arc Lamp. Barton B. Ward, New York, N. Y.

492,150. Process of Coating Conductors for Incandescent Lamps. Thomas A. Edison, Menlo Park, N. J.

492,151. Dynamo Electric Machine. Wallace E. Freeman, Long Island City, N. Y.

492,160. Electric Elevator. Frank E. Herdman, Indianapolis, Ind.

492,176. Commutator for Dynamos or Motors. Joseph A. Williams, Cleveland, O.

492,200. Electric Arc Lamp. Henry Harper, London, Eng.

492,201. Electric Arc Lamp. Henry Harper, London, Eng.

492,215. Hanger for Electric Incandescent Lamps. Samuel O. Larkins, Blair, Neb.

492,219. Lighting Conductor and Arrester. Adelvin B. Lyman, Cleveland, O.

492,236. Low Water Indicator for Boilers. William H. Rodgers, Bay Side, N. Y.

492,244. Method of Constructing Armature Cores for Electric Motors or Dynamos. Albert W. Smith, San Francisco, Cal.

492,245. Magnetic Tool. Jacob F. Standiford, Muscogee, Ind. Ter.

492,247. Electrical Foot Warmer. William E Ulmer, Hoquiam, Wash.

492,265. Conduit Electric Railway. Fred. W. Brann, Oakland, Cal.

492,301. Coupling for Trolley Wires. William H. Keckeley, Covington, Ky.

492,291. Commutating Apparatus for Dynamo Electric Machines. Edward J. Houghton and William White, London, Eng.

492,309. Electric Bell Alarm. Gustaf L. Reenstierna, Boston, Mass.

492,330. Electric Burglar Alarm. Julius Kamsler, New York, N. Y.

492,355. Magnetic Core for Armatures. Thomas H. Hicks, Detroit, Mich.

492,353. Registering Turnstile. Clarence P. Gott, New York, N. Y.

492,377. Electric Reduction of Refractory Metallic Compounds. Thomas L. Willson, Leaksville, N. C.

492,312. Electric Arc Lamp. John Thompson, New York, N. Y.

Eugene F. Phillips, Prest. W. A. Hathaway, Treas. W. H. Sawyer, Sec'y.

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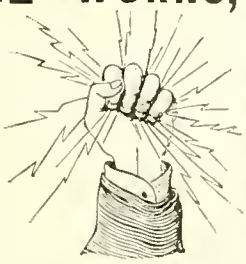

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In a letter from the Inspector of the Boston Fire Underwriters' Union, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY and MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

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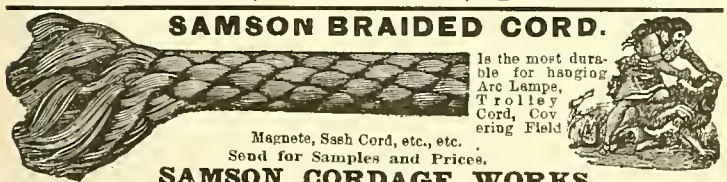

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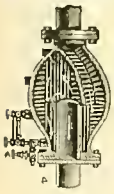

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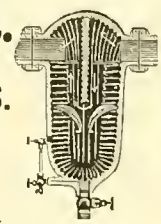

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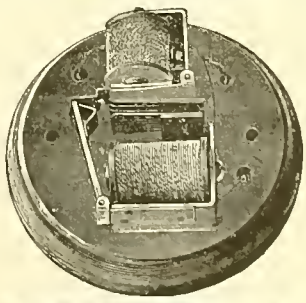

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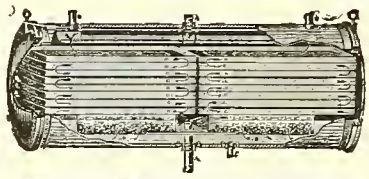

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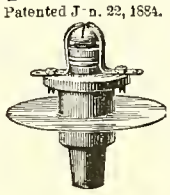

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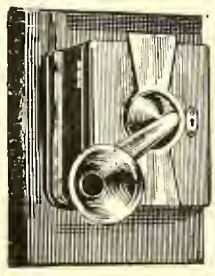

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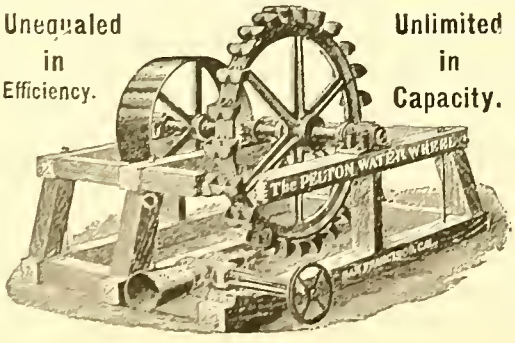

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The advantages the Pelton Wheel affords in the way of an uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

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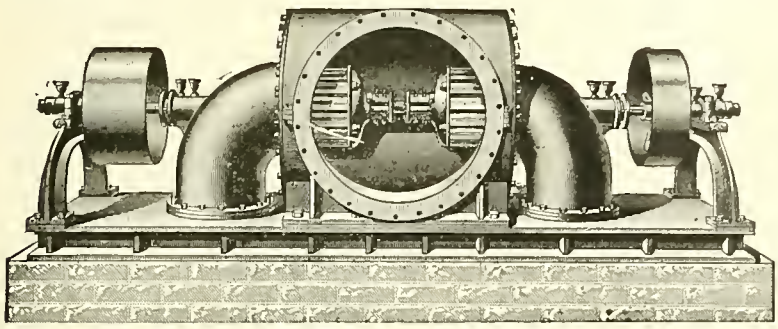

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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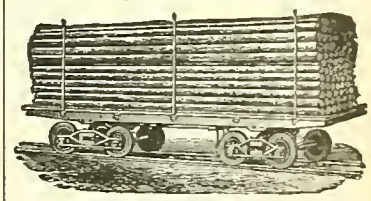

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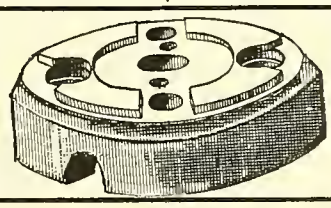

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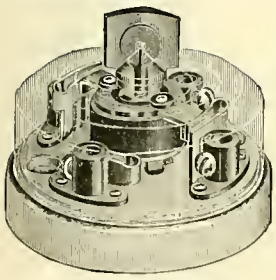

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HART SWITCHES.

SINGLE AND DOUBLE POLE.

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Electric Street Railway Tower Wagon.

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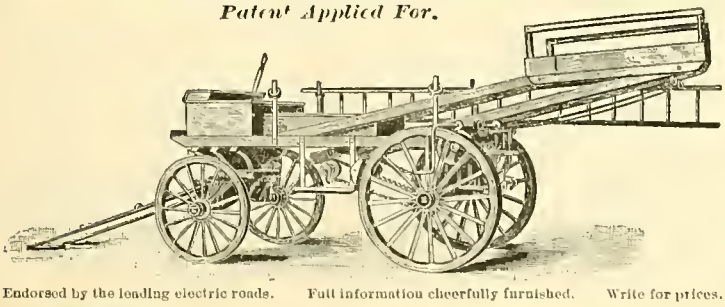

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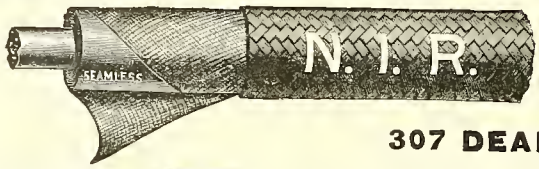

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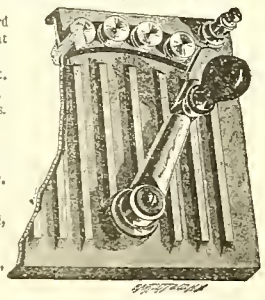

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Rheostats of every size and kind such as Motor Starters, Field Regulators, Stage Regulators, Equalizers, etc., having resistance up to 2,000 ohms and current capacity up to 200 amperes.

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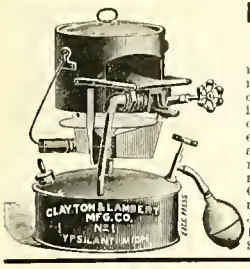

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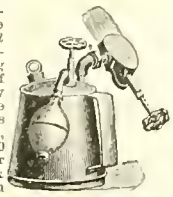

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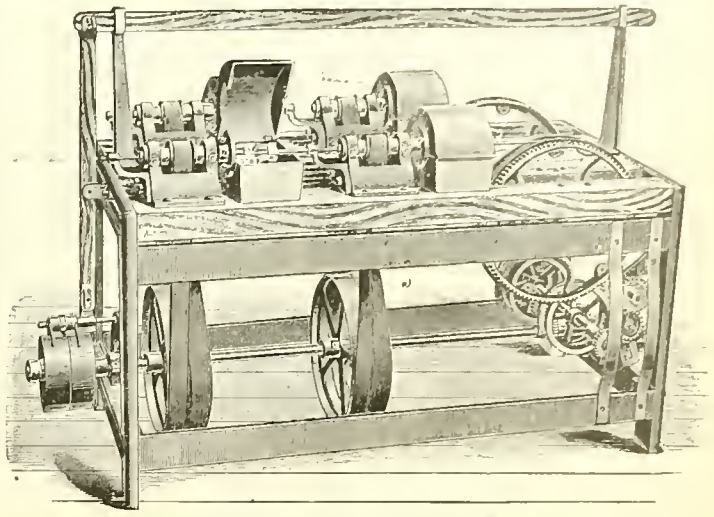

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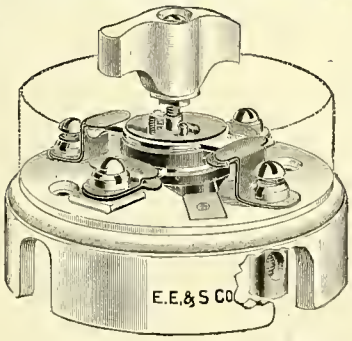

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Yet to be Excelled.

Rubbing Contacts.

A trial is Asked.

Compact in Form.

Used Everywhere.

Sure Quick Break.

Endorsed by Users.

25 AMPERE DOUBLE POLE SNAP SWITCH.

This switch has more carrying capacity than most switches designed for 25 amperes, and the wiping contacts constantly keeping the surface clean, the parts a ways run cool. The sudden break is of such length as to make the switch safe for use with currents of an E. M. F. of from 400 to 600 volts.

This switch is finished in the same neat and workmanlike manner as are all our goods. Send for sample. Furnished with either rubber or porcelain key. Send for our Catalogue.

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DO your BELTS BLACKEN the CEILING, the WALLS, or the FLOOR?

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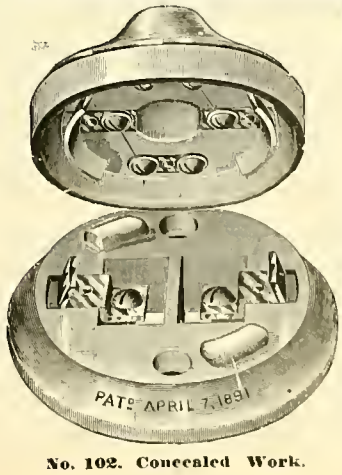

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Plenty of Room for Knot in the Cord.
Strong on Fixtures; the Cap, with Bayouet Lock, Projecting over the Shell.

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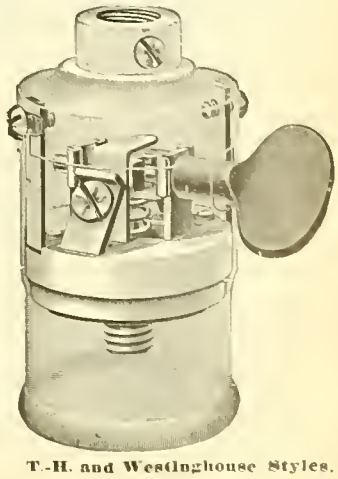


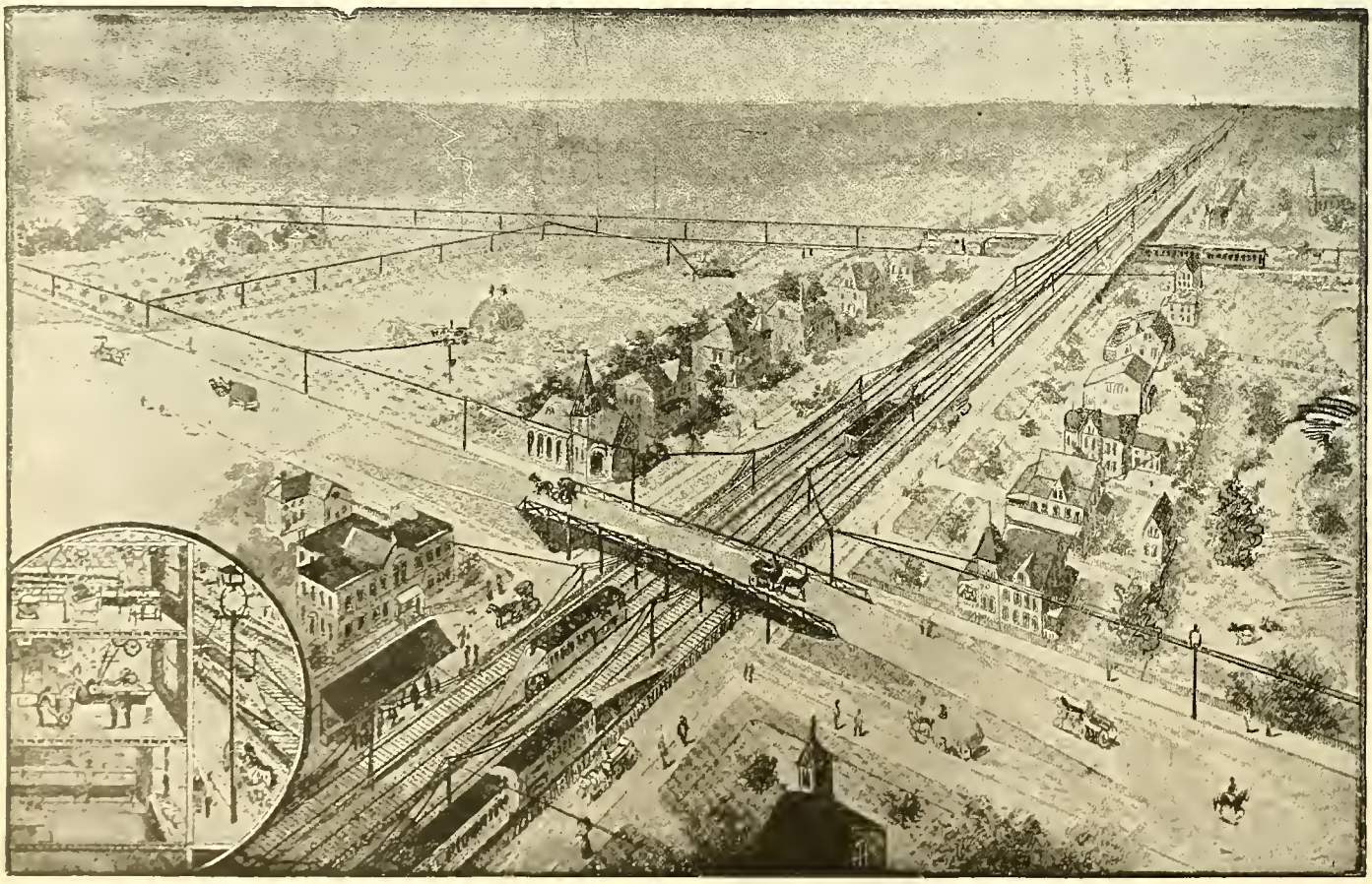
T.-H. and Westinghouse Styles.

Chicago and St. Louis Electric Railroad.

Since work was begun on the road-bed on Oct. 6, 1892, the progress of the road has been of a most satisfactory nature. While perhaps slower than enthusiasts might desire, yet the progress has been steady and sure and of a character to engender confidence in the skeptical. A contract was let at first calling for grading through Christian County, but since then a contract for the complete road-bed from Chicago to St. Louis has been awarded to Bagnell Bros. of St. Louis, and Garvey Bros. of Memphis. It includes grading, ties, rails, steel bridges over rivers, culverts, steel bridges over railroads, overhead crossings of all wagon roads, and, in fact, a complete standard, double track road-bed between the cities named, everything being of standard steam construction. This contract is most valuable, as the contractors accept one-half of the total payments in first mortgage bonds of the company *at par*. Moreover the contract price is well within the first estimates of the company, and stops the adverse criticism that was aroused by the low figure at which the cost of the road was placed. While coming well within the estimates upon which the financial plan of the company has been laid, the specifications have been so added to and improved as to make the road far superior to the one first contemplated. 72 pound steel rails are to be used, all bridges over railroads are to be of steel, spanning the right-of-way of the road which is crossed and insuring the electric road against the delaying tactics which would be employed by steam roads if pillars had to be built on the right-of-way of steam roads.

In its bill before Congress the road has met with very promising success. The bill was first introduced by Senator Vest in the Senate and Congressman Foreman in the House, and has already been favorably reported by the Committees on Commerce and on finance of the Senate. The bill has a splendid chance of being passed.

The financial condition of the company is excellent, and ample funds are on hand to carry on the work contemplated for the remainder of the Winter, such as procuring the rest of the right-of-way, and getting things in condition to begin work in earnest in the Spring. No stock is being advertised for sale, and none will be until the bonds have been floated, as the company is in so strong a position that it can well afford to wait.



The Chicago & St. Louis Electric Railroad Company at first had the honor of calling itself the pioneer in long distance rapid transit by electricity, but to-day we have rivals, for the press of this country now states that enterprising little Belgium will run trains at nearly 150 miles an hour during the coming summer, and that France and Germany are each to have a road over which trains will be run at more than 100 miles an hour. Six months or a year ago, there were very few persons who would admit the possibility of running trains at 100 miles an hour. Happily for us the sentiment has changed, and it is now admitted almost universally that the only question is one of finance.

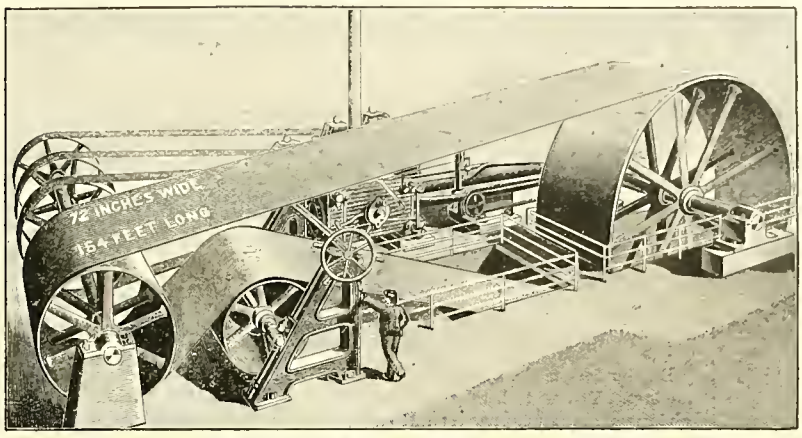
The plan for future work is extensive and conservative. As soon as the weather breaks in the Spring, a section of single track ten miles long is to be equipped and run; not that it is necessary, but to effectually remove any uncertainty in the minds of the general public, and to demonstrate to the world the feasibility of the plan.

The company will be glad to furnish illustrated prospectus upon application by mail either to its office in St. Louis or Chicago.

When trains are run 100 miles an hour over ten miles of track, then those who say the Chicago & St. Louis Electric Road will not be built, and will not pay, will be sadly behind the progress of the age.

The Chicago & St. Louis Electric Railroad will be built, and trains will run over it at the rate of 100 miles an hour.

THIS SPEAKS FOR ITSELF.



POWER STATION OF ST. LOUIS & SUBURBAN R. R CO

This Plant is belted with three 72-inch belts, each 154 feet long, two 34-inch and ten 16-inch generator belts, all of which are of our double Shultz Patent Sable Rawhide.

SHULTZ BELTING CO.,

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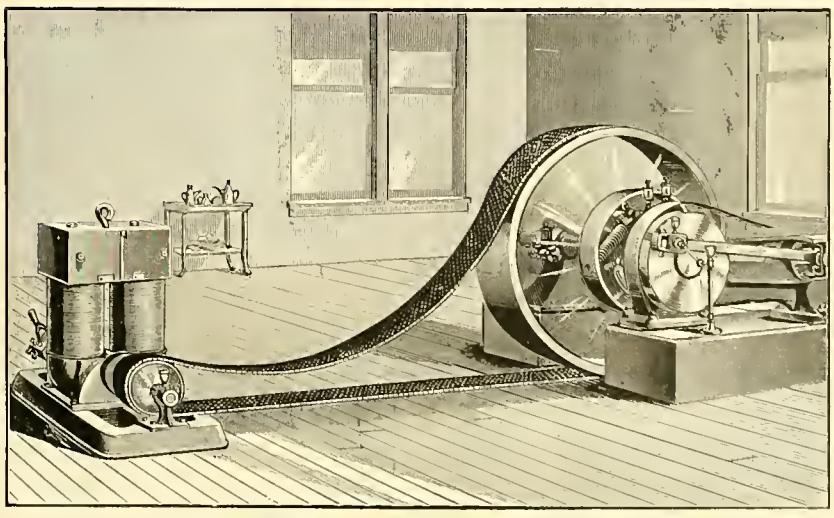

VIEW OF SHULTZ PATENT WOVEN LEATHER (Link) BELT.

Taken while running at the St. Louis Electric Power Company's Plant, 210 Lucas Avenue, St. Louis, Mo.
The above Cut shows how the belt should be run; slack side on top and not too taut.

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MANUFACTURERS OF THE

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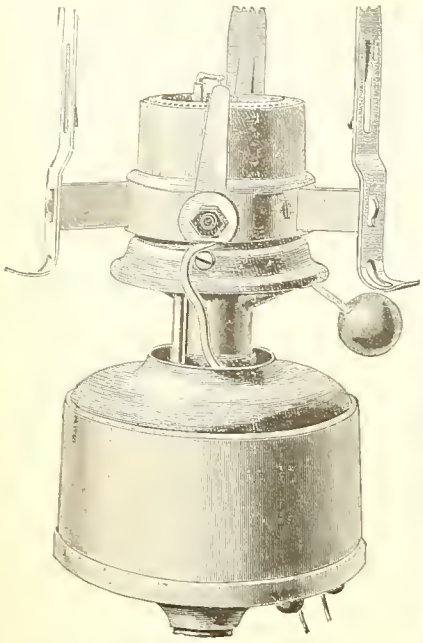
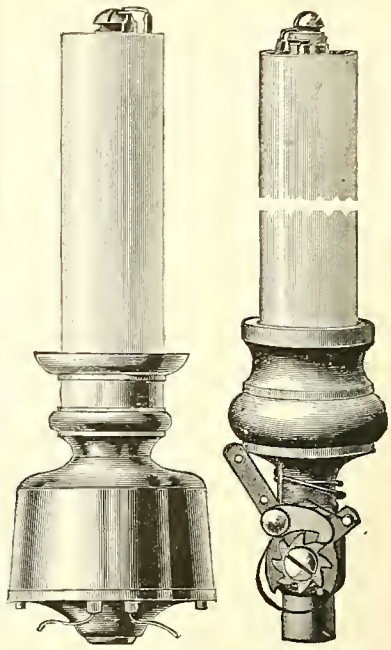
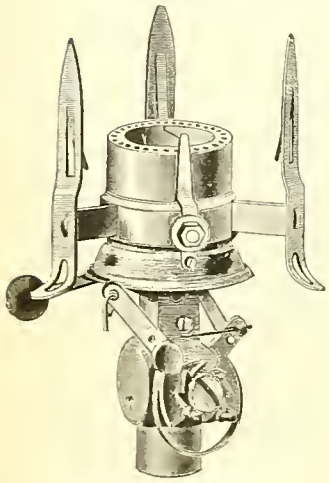
Buy burners made by the BOSTON ELECTRIC CO., and get the best. You will thereby save the profits of your labor, besides giving your customers perfect satisfaction.



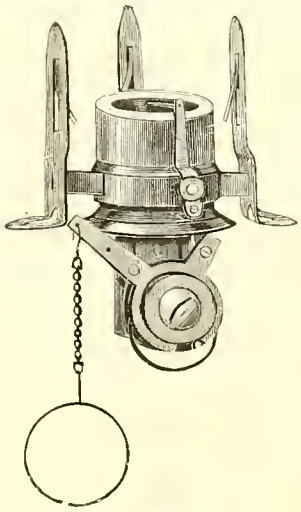
Argand Automatic Burner.



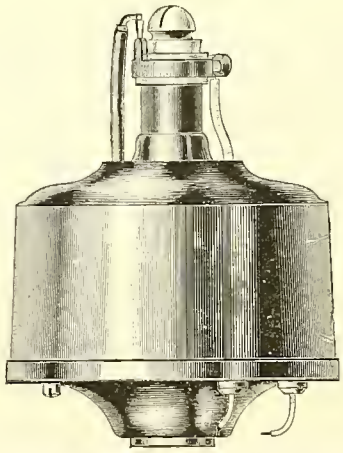
Candle Auto. Burner. Ratchet Candle.



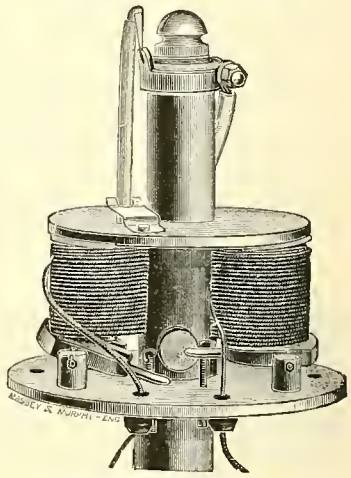
Ratchet Argand Burner.



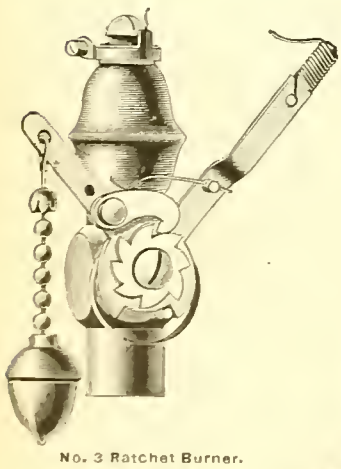
Plain Argand Burner.



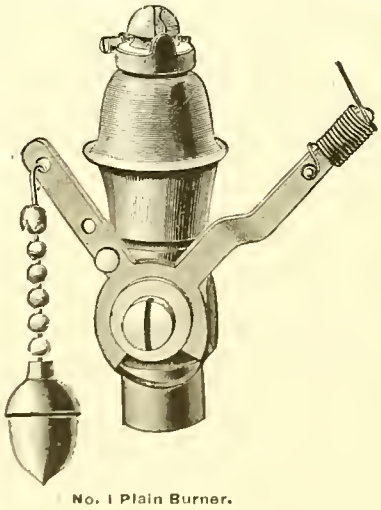
Boston Electric Co.'s Automatic Burner.



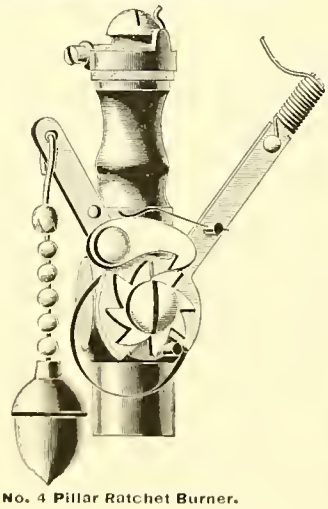
Boston Electric Automatic Burner.
(Shell removed.)



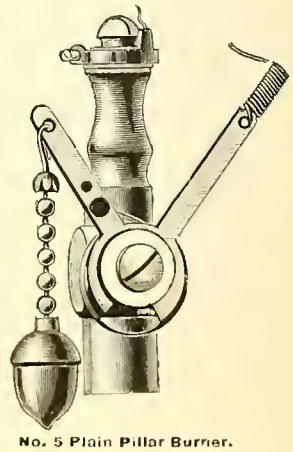
No. 3 Ratchet Burner.



No. 1 Plain Burner.

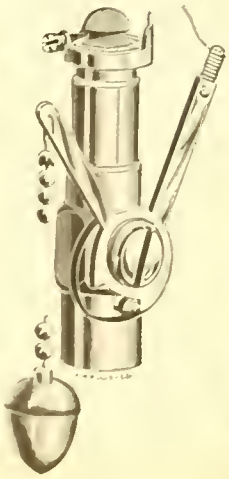


No. 4 Pillar Ratchet Burner.

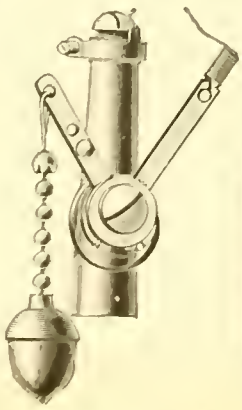


No. 5 Plain Pillar Burner.

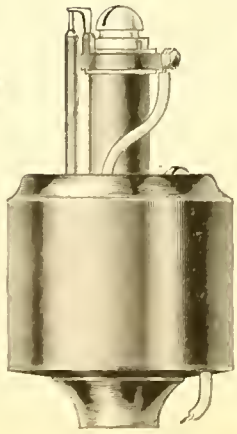
No. 2 Plain Burner.



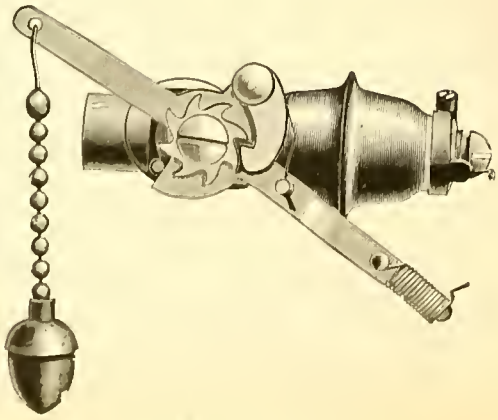
No. 2 1/2 Plain Burner.



Plain Factory Burner.



Vibrator Burner.



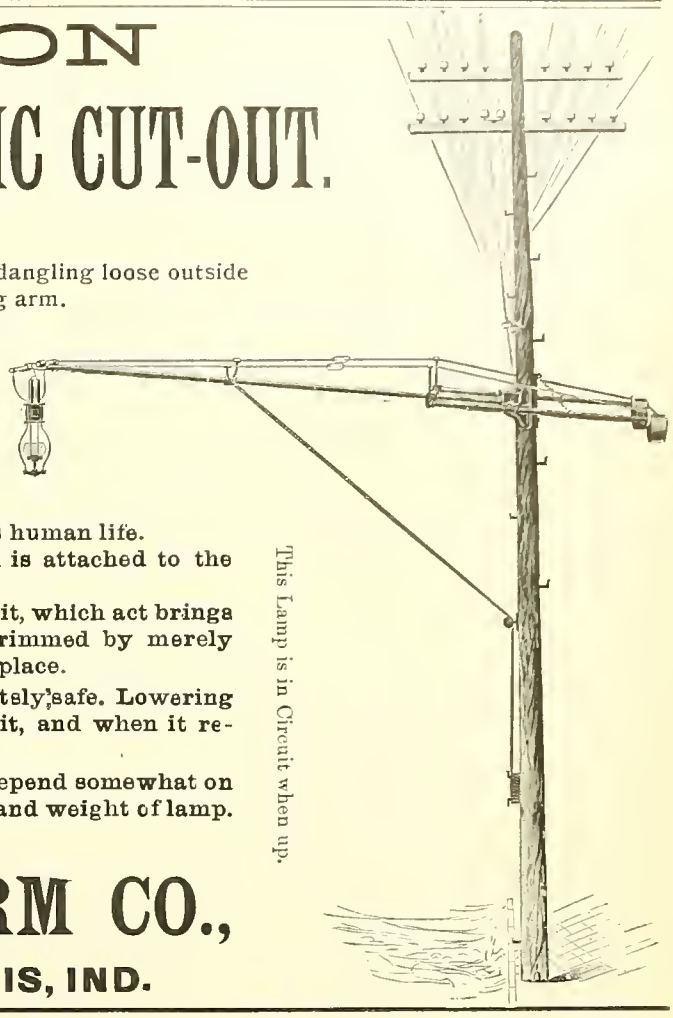
Ratchet Billiard Burner.

THE DILLON

MAST ARM AND AUTOMATIC CUT-OUT.

PATENTED JUNE 16, 1891.

Wires connecting lamp with line are on inside arm proper, not dangling loose outside and requiring that much less wire after erecting arm.



This Lamp is in Circuit when up.

This Mast Arm embraces the following points of superiority:

1. It is very light.
2. It is very strong and easy to put up.
3. It leaves the top of the pole free for Cross Arm.
4. It can be quickly trimmed.
5. It is absolutely safe and harmless, a feature as important as human life.

The arm atrides the pole at any distance below the top desired, and is attached to the pole by a very strong bracket.

It can be quickly trimmed. All that is necessary to do is to lower it, which act brings it to the foot of the pole, out of the way of travel, and when trimmed by merely letting it go it goes quickly and automatically and firmly to its place.

It is constructed with an automatic cut out, which makes it absolutely safe. Lowering the lamp for trimming instantly cuts it completely out of circuit, and when it returns to place it automatically cuts itself in.

Arms can be furnished from 20 to 30 feet in length. Price will depend somewhat on the length. Parties desiring them should give name of system and weight of lamp.

Address

THE DILLON MAST ARM CO.,

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USE INSULLAC AND BE HAPPY.

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THE MORRISON STORAGE BATTERY

Is made by the Planté process, no oxides being used, either mechanically or applied in the form of paste, paint or cement.

ELECTROMOTIVE FORCE HIGH; LIFE LONG.

Dry Batteries, Battery Supplies, etc. For further information address

AMERICAN BATTERY COMPANY,

Office: Rooms 23 and 24, 177 La Salle St., CHICAGO, ILL.

C-S SPECIALTIES.

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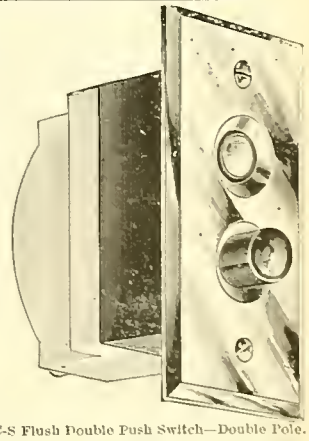

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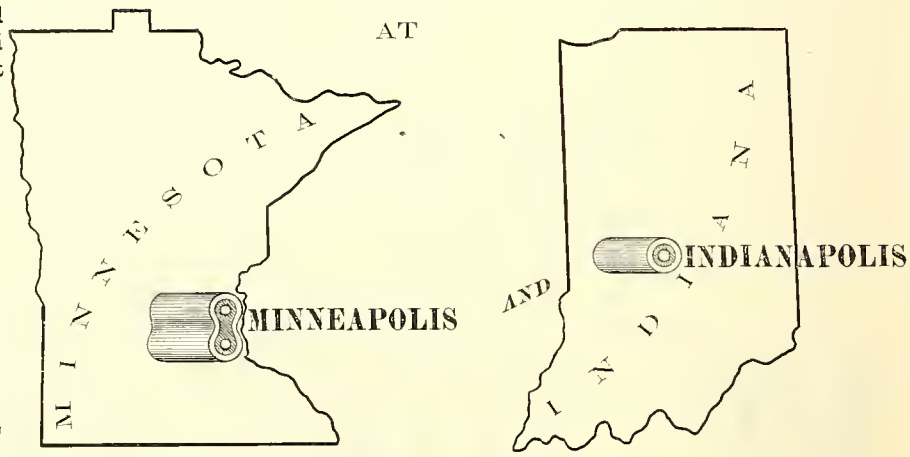

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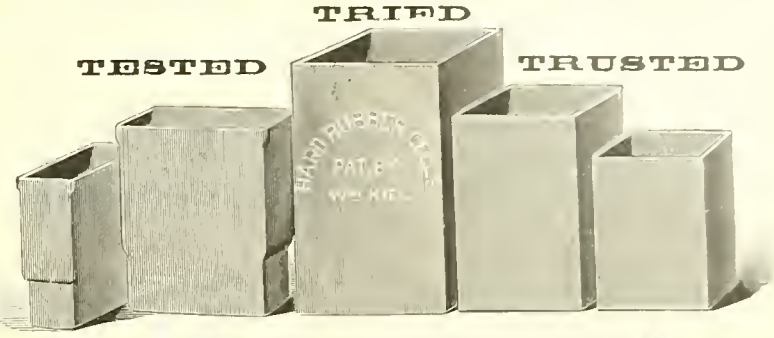

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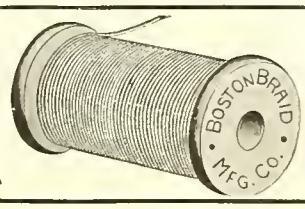

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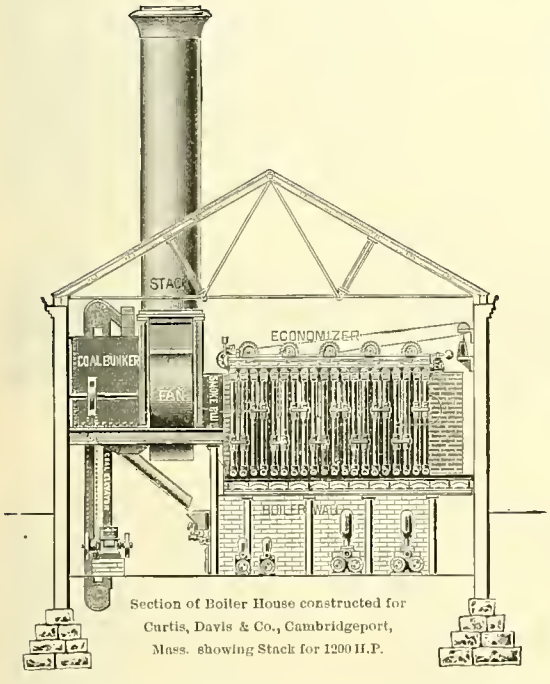

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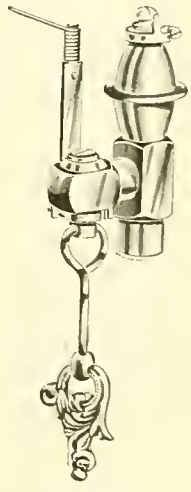

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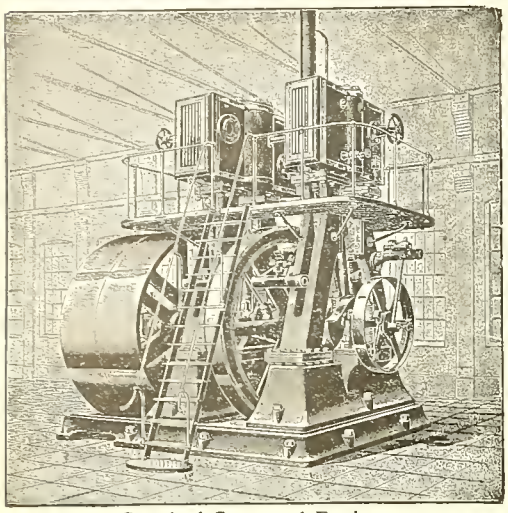

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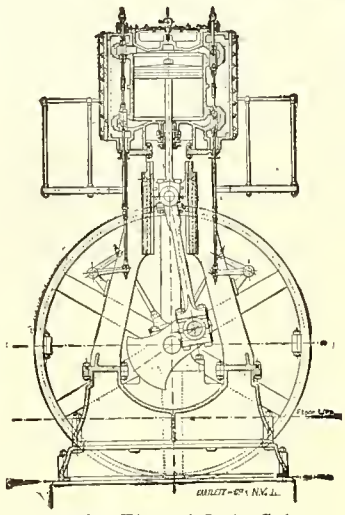

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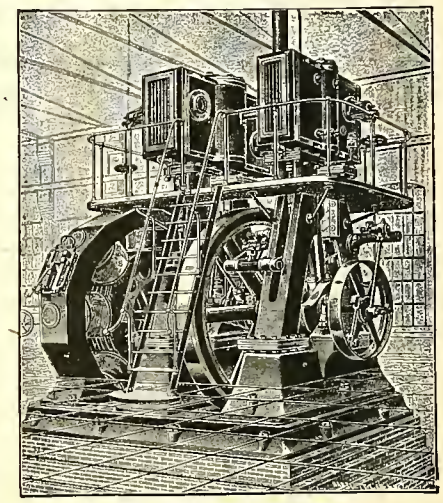

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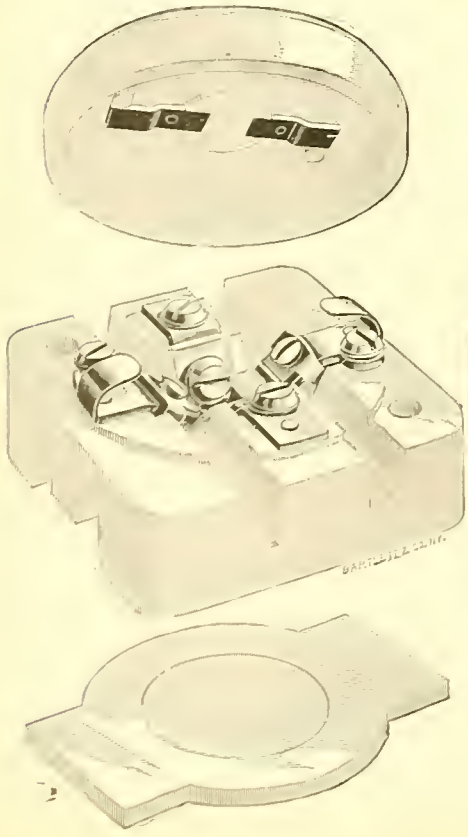

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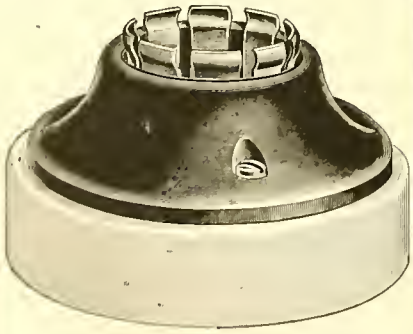

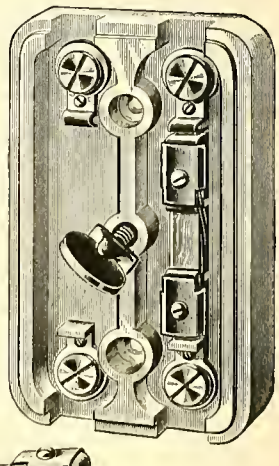

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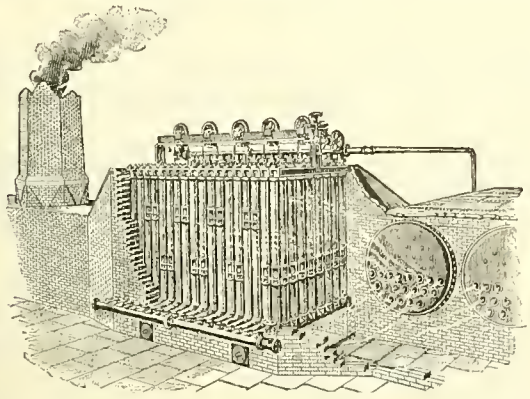

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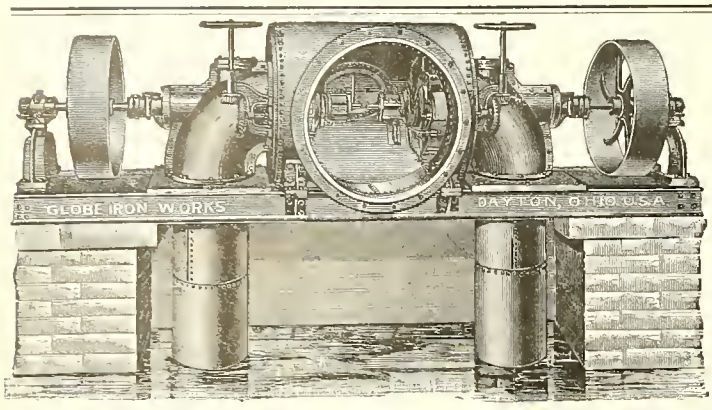

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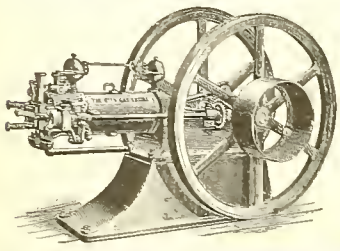

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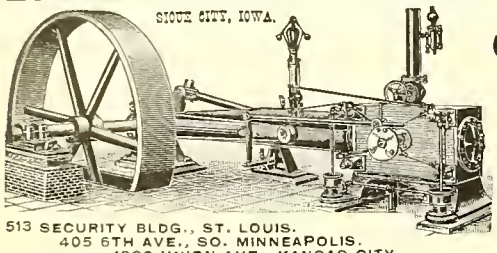

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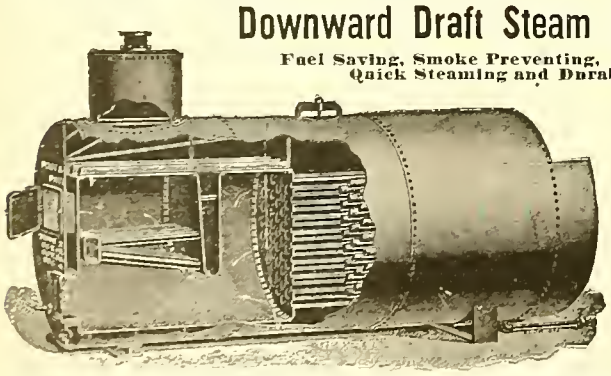

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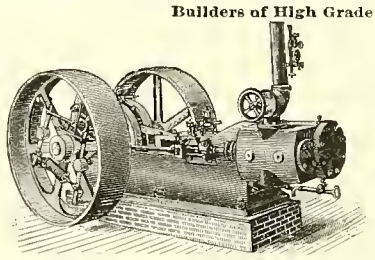

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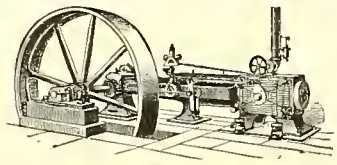

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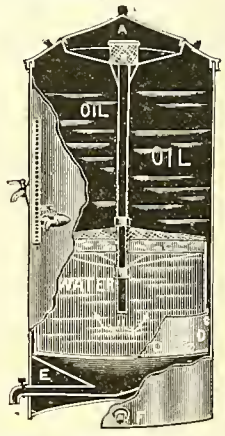

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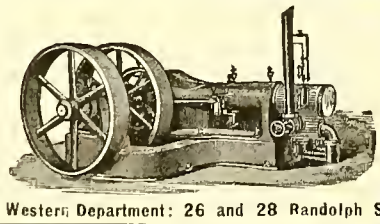

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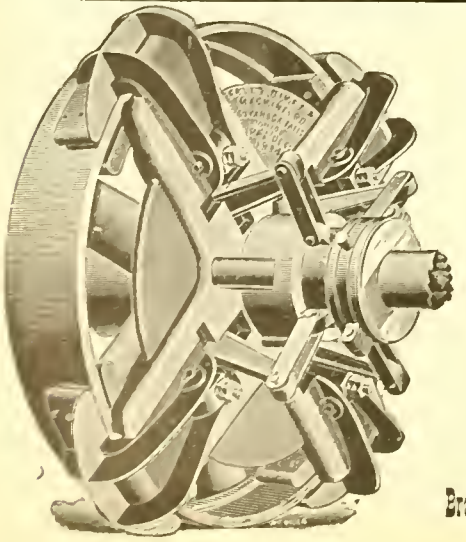

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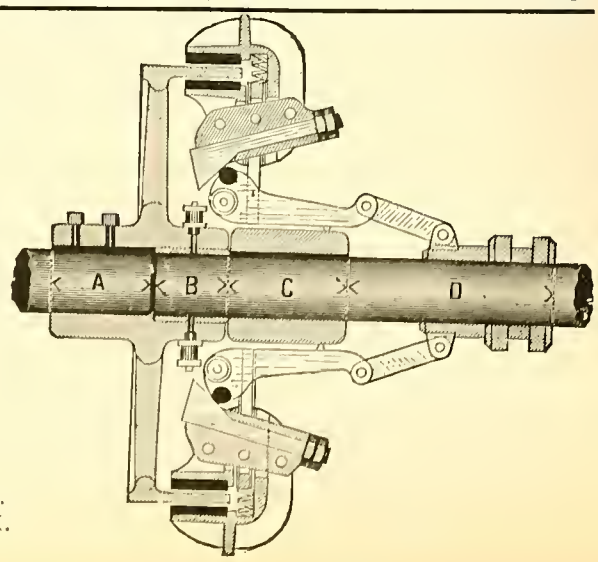

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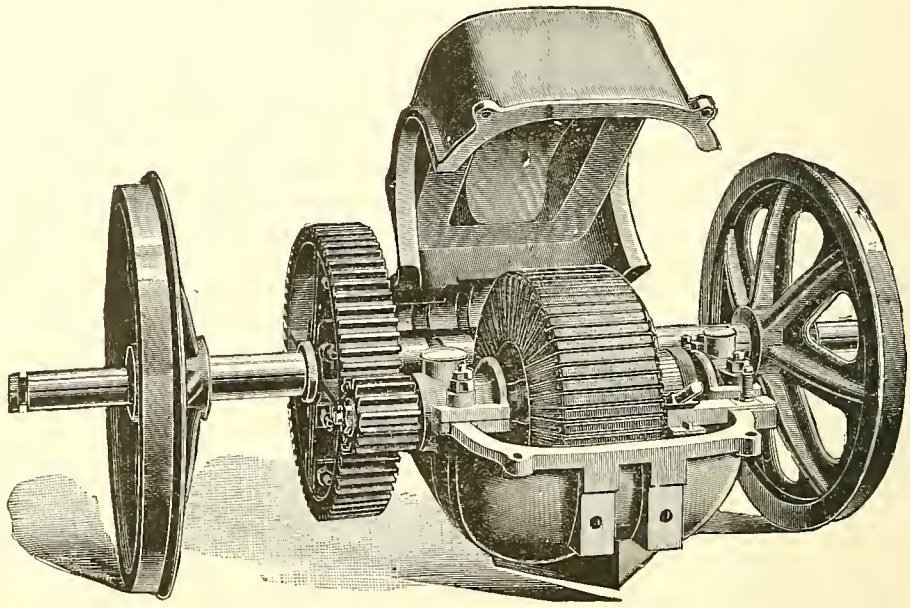

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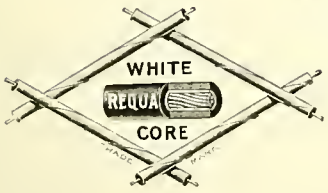

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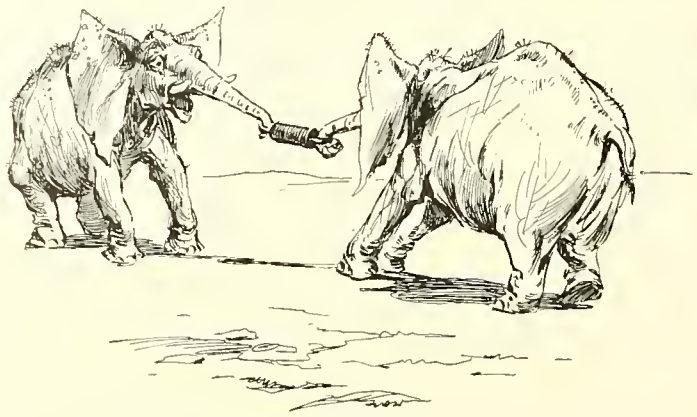
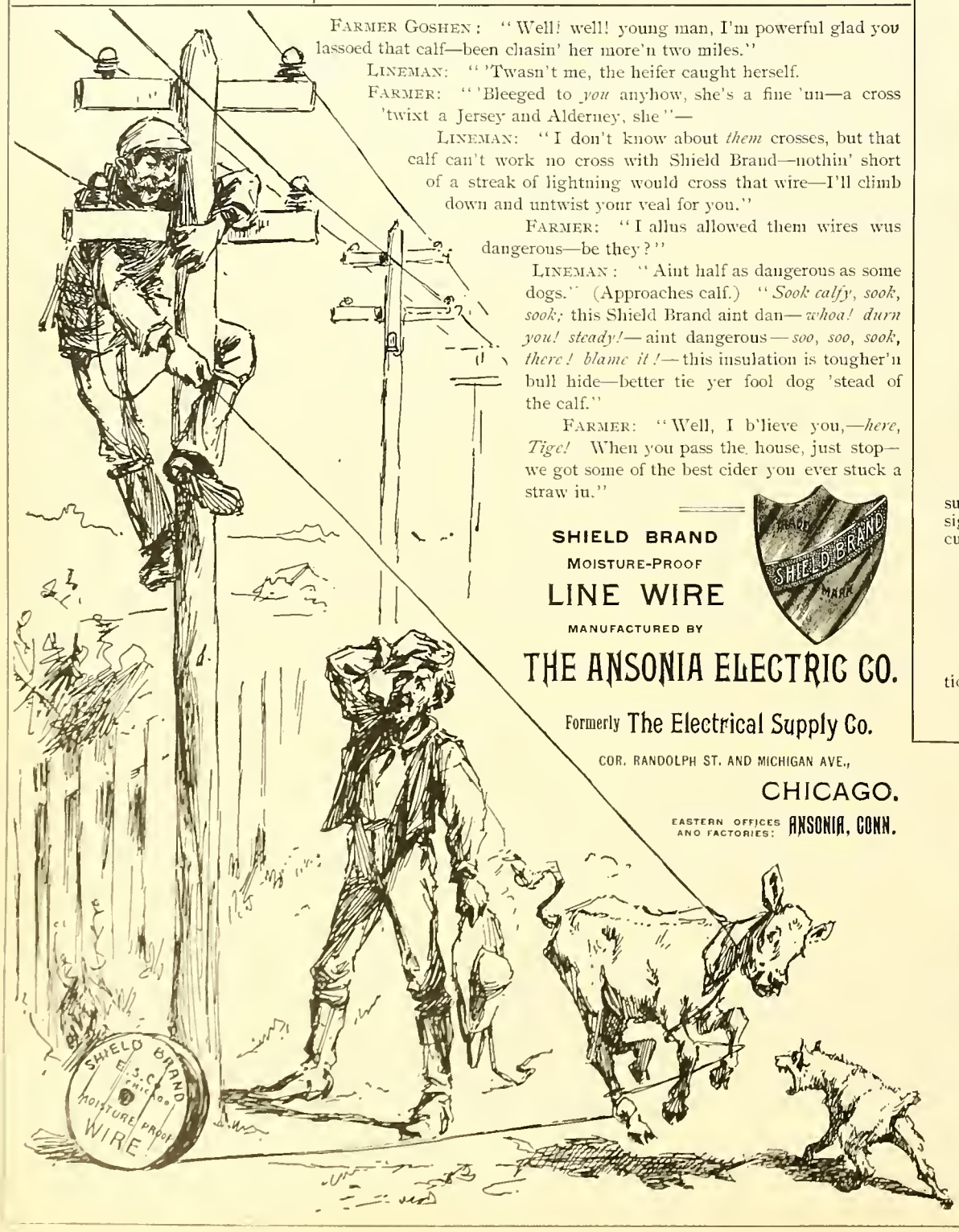


III. ABDUL:—"All right let's pull it—maybe it will squeak."
BIM:—"Well, you ready? Heads I win, tails I loose. Pull!"



FARMER GOSHEN: "Well! well! young man, I'm powerful glad you lassoed that calf—been chasin' her more'n two miles."

LINEMAN: "'Twasn't me, the heifer caught herself.

FARMER: "'Bleeged to *you* anyhow, she's a fine 'un—a cross 'twixt a Jersey and Alderney, she"—

LINEMAN: "I don't know about *them* crosses, but that calf can't work no cross with Shield Brand—nothin' short of a streak of lightning would cross that wire—I'll climb down and untwist your veal for you."

FARMER: "I allus allowed them wires wus dangerous—be they?"

LINEMAN: "Aint half as dangerous as some dogs." (Approaches calf.) "*Sook calfy, sook, sook;* this Shield Brand aint dan—*whoa! durn you! steady!*—aint dangerous—*soo, soo, sook, there! blame it!*—this insulation is tougher'n bull hide—better tie yer fool dog 'stead of the calf."

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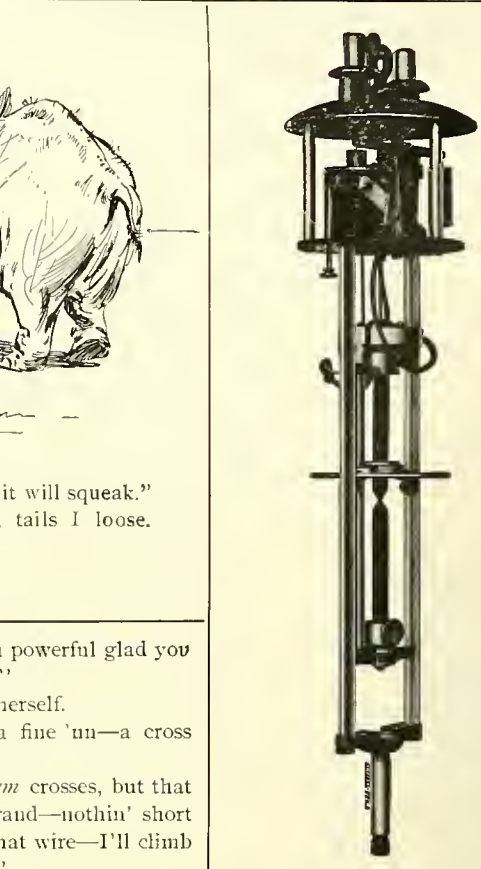

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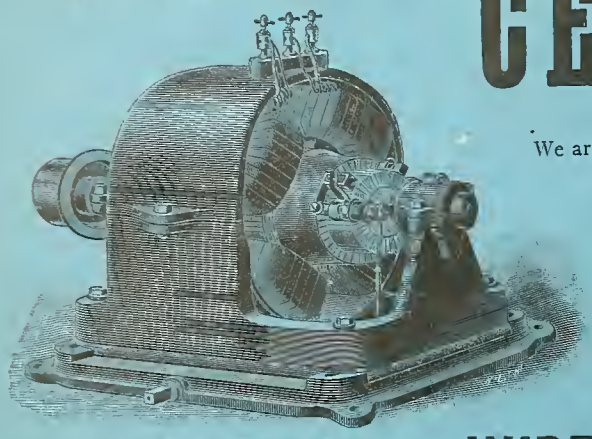

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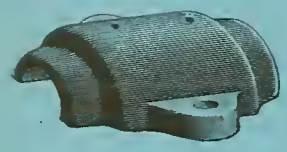

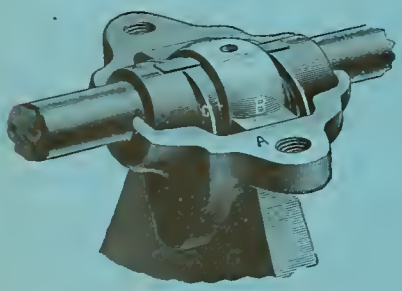

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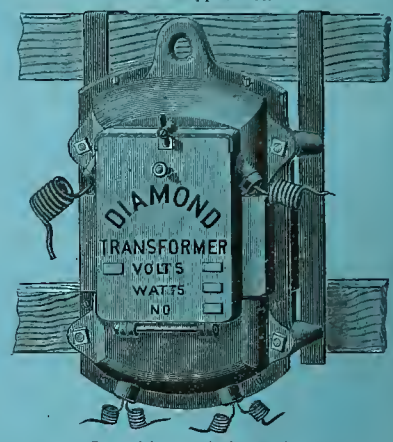

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The main points to be attained in a Transformer are:

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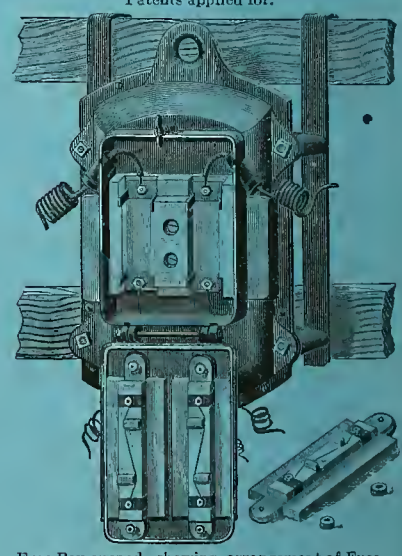

Fuse Box opened, showing arrangement of Fuse.

In case repairs are needed the cost on the Diamond is but a trifle compared to a Transformer that must be built over again. By having separable coils it is but a small matter to replace them.

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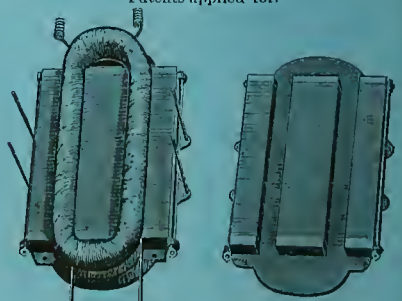

Showing arrangement of separable coils.

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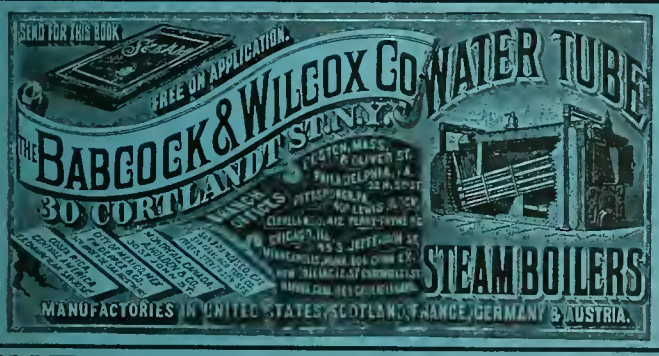

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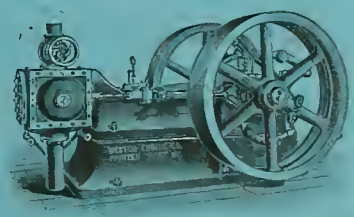

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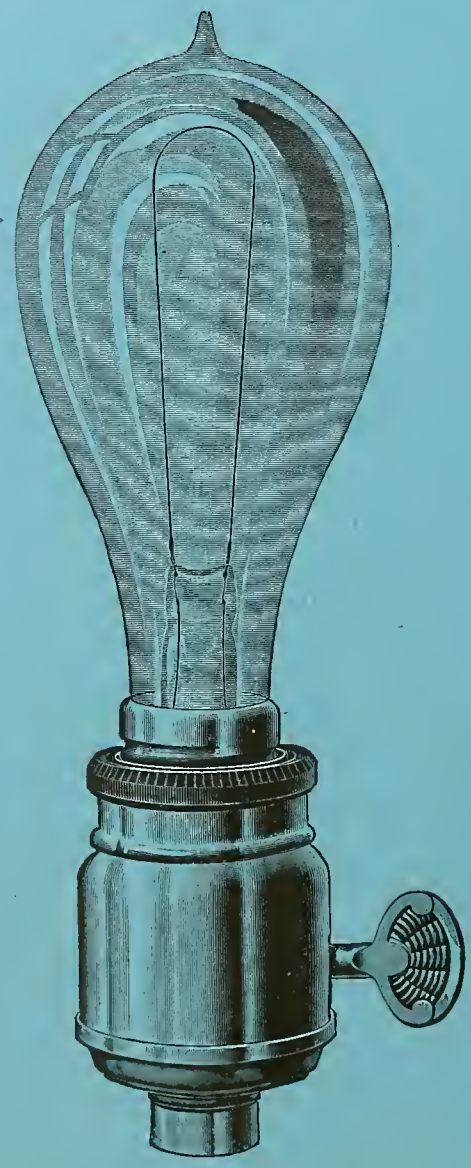

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Central Electric Co.
Knapp Electrical Works.
Ostrander & Co., W. R.
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Knapp Electrical Works.
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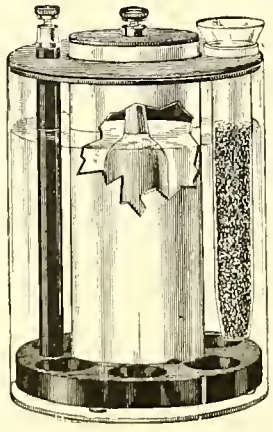

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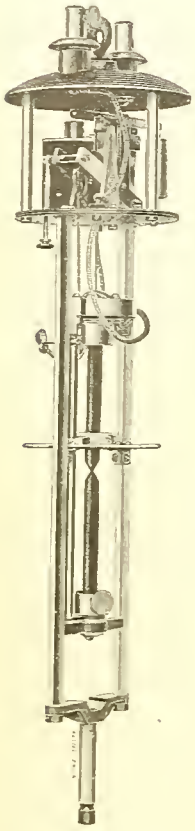

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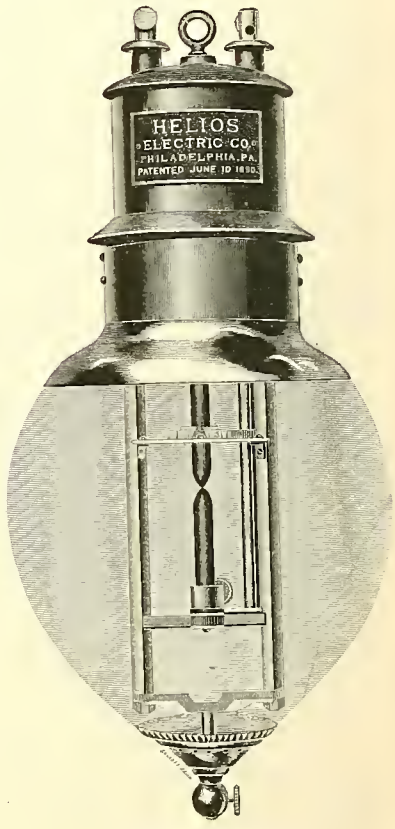

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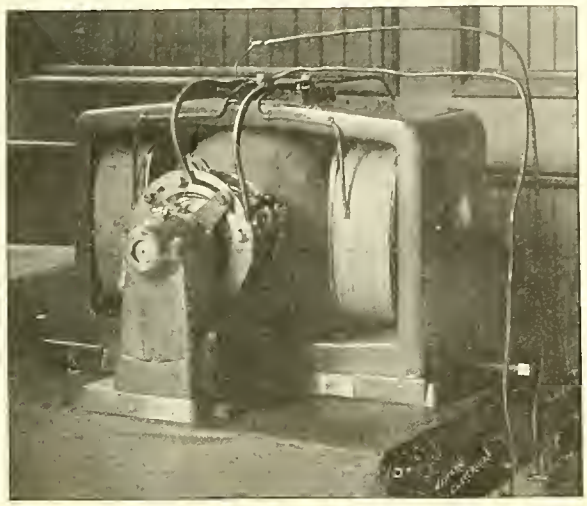

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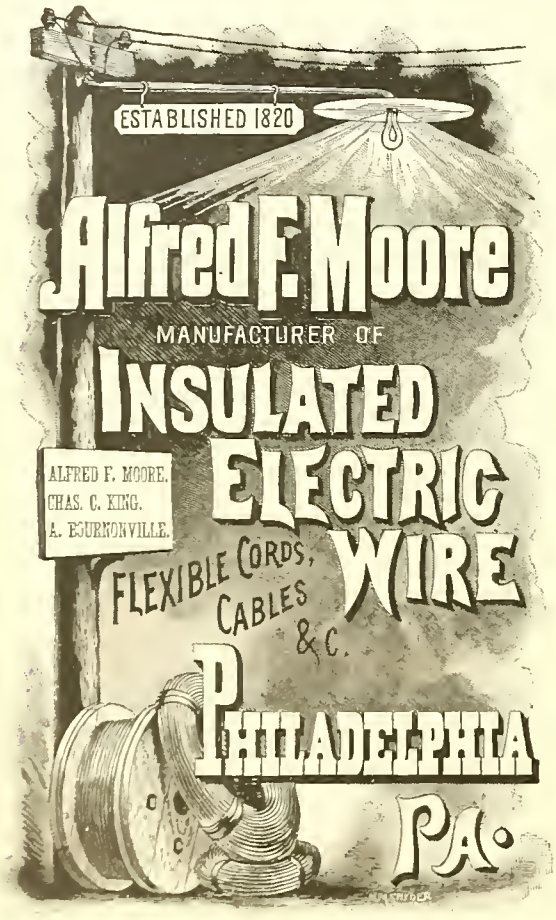

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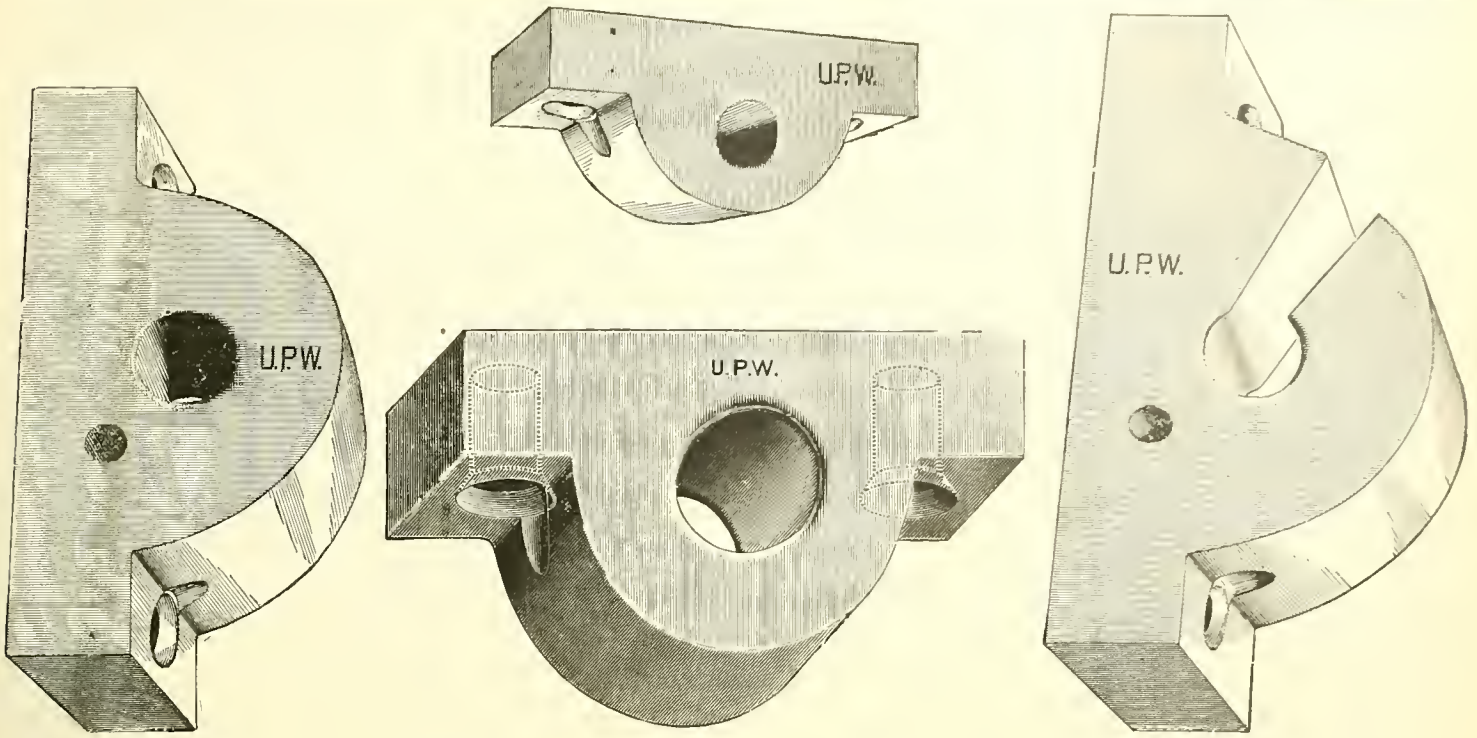

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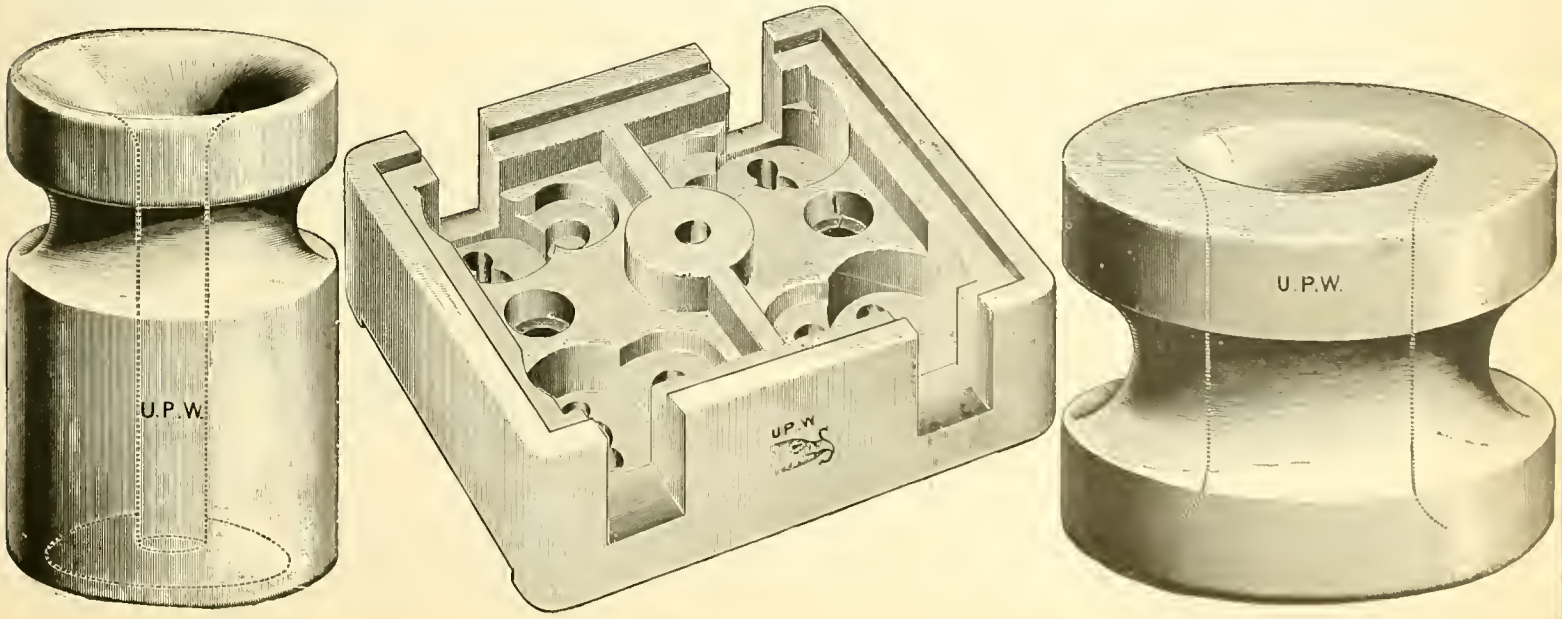

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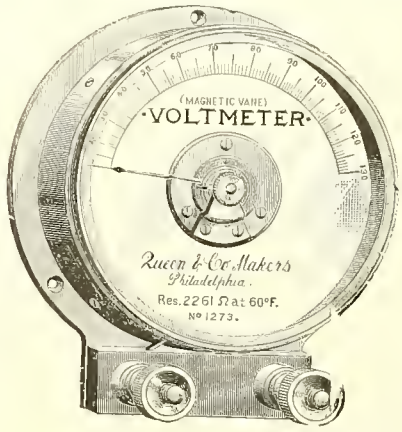

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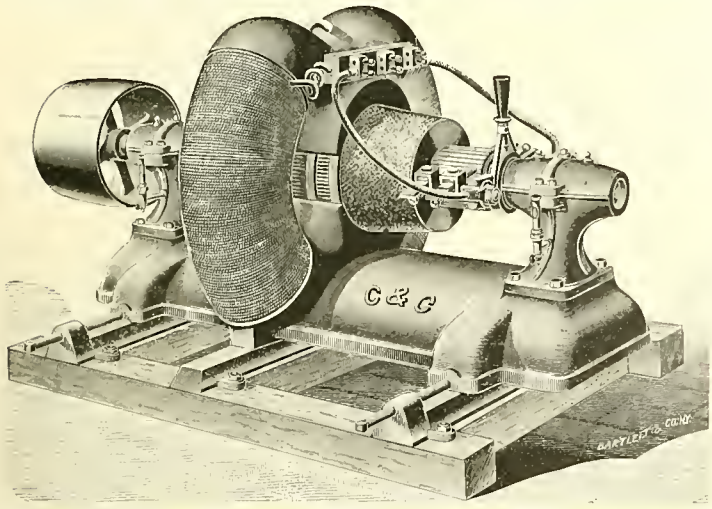

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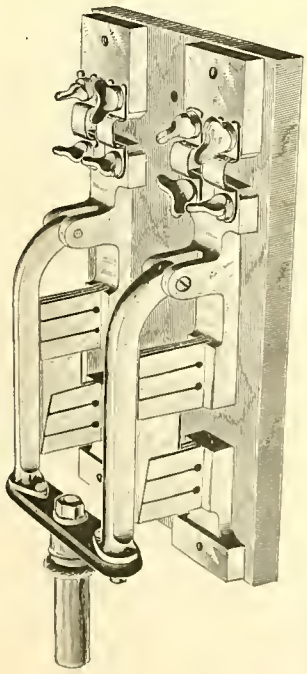

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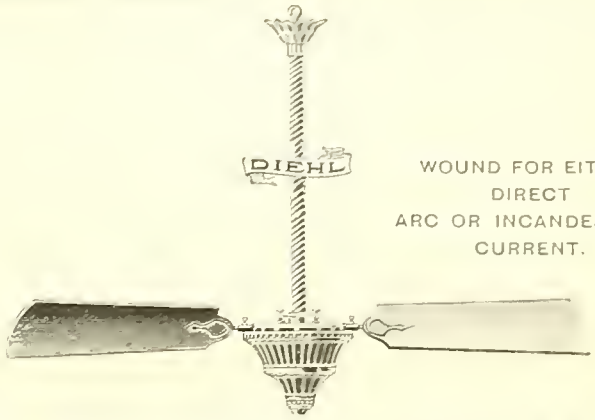

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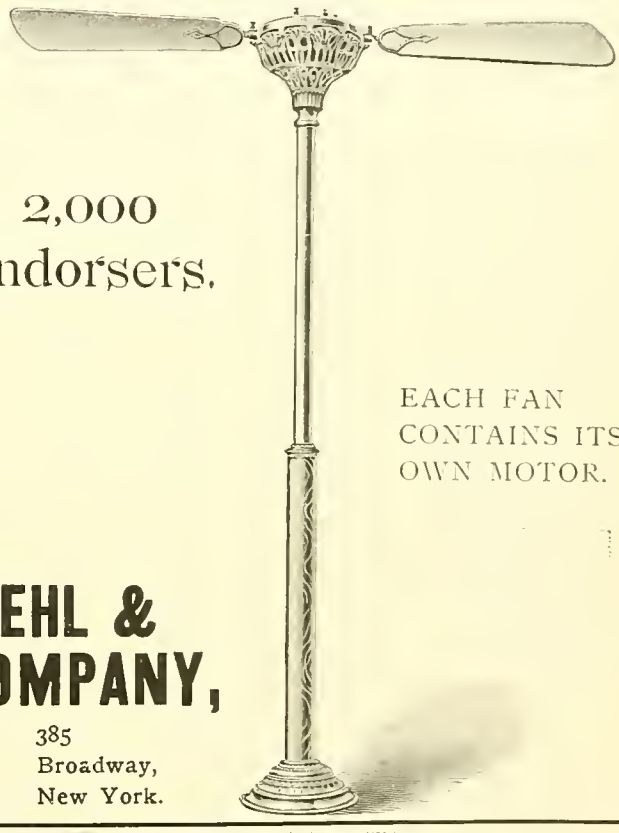

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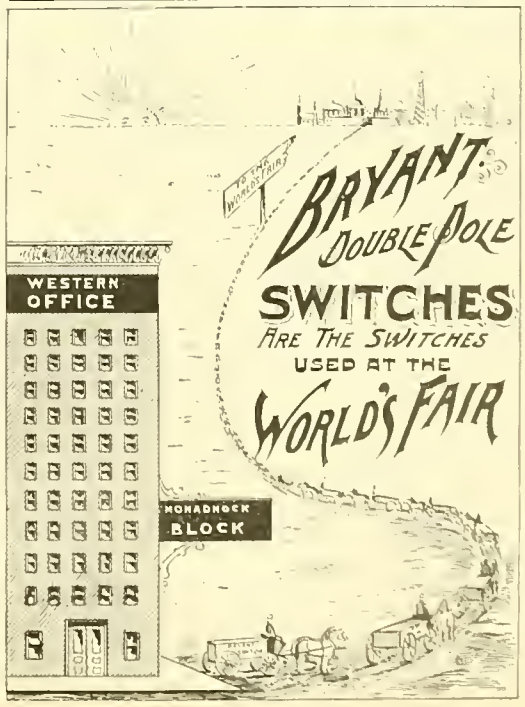

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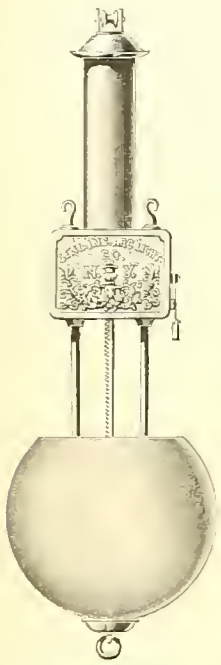

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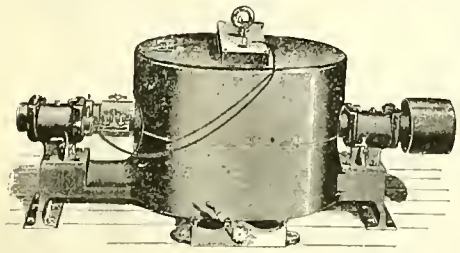

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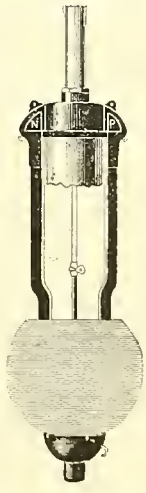

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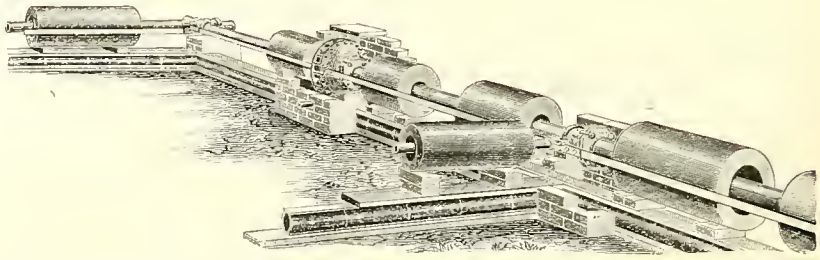

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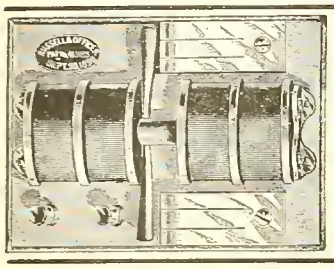

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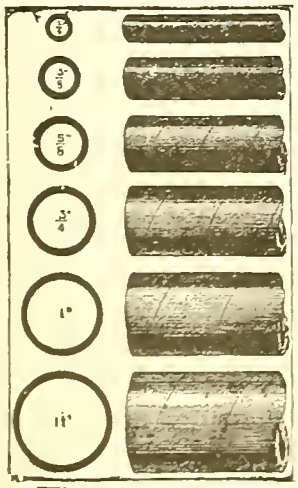

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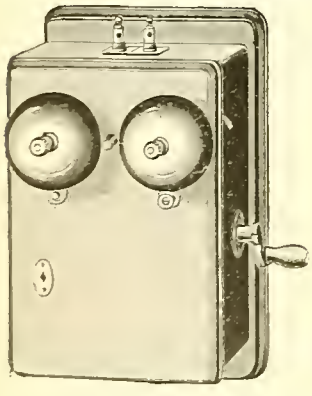

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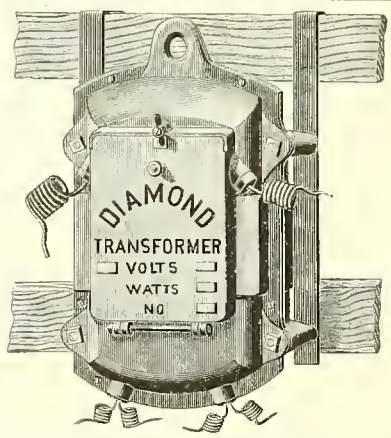

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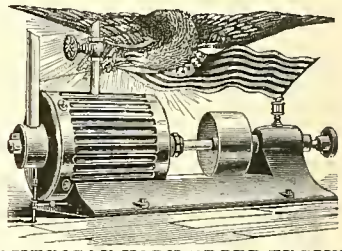

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NOTICE.

January 27, 1893.

To the Electrical Trade:

I have this day assigned the entire interest in the Cleveland Switch, Patent No. 391,512, to THE BRYANT ELECTRIC COMPANY, of Bridgeport, Conn., together with the tools, patterns and moulds for making the Switches and Arc Cut-outs formerly manufactured and sold by THE FOREST CITY ELECTRIC WORKS, of Cleveland (Factory, Geneva, Ohio).

I trust that my former friends and patrons will extend to them the same good will and patronage that they have shown me in the past.

Very respectfully, (Signed) W. B. CLEVELAND.

THE BRYANT ELECTRIC CO. MAKES GOOD GOODS.

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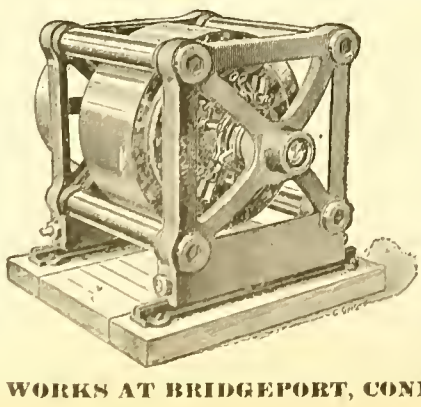

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WORKS AT BRIDGEPORT, CONN.

Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, MARCH 11, 1893. No. 10

E. A. Armstrong, President of the National Electric Light Association.

In the selection of the Hon. Edward A. Armstrong as president of the National Electric Light association that organization has secured an admirable executive officer. Judge Armstrong has been an active member of the association for several years. He is thoroughly acquainted with the purposes and needs of the organization, and is in entire sympathy with its policy. He has served on several important committees, and his familiarity with the details of the work in hand will be of service to him in extending the power and scope of the organization. His professional training and experience will also aid him materially.

Judge Armstrong is still a young man, as a glance at the accompanying portrait will show. He was born in Salem county, New Jersey, December 25, 1858. After finishing his education he took up the study of law, and was admitted to the bar in February, 1880. Shortly afterwards he removed to Camden, and has since practiced law in that city, building up a lucrative business and establishing an excellent reputation throughout the state. In 1884 he was elected member of the state Legislature, and was re-elected for three successive terms. His work in that body attracted considerable attention, and brought him into prominence in state politics. He took an interest in legislative work and soon developed the qualifications of leadership which made him conspicuous in his party's councils. His ability was recognized and his services in the Legislature were rewarded. He was chosen speaker of the Assembly in 1885 and again in 1886, and during both of these terms proved that the confidence of his associates was fully merited. After serving four terms in the Legislature, Judge Armstrong ceased to take an active part in politics. In 1888 he was made judge of the Camden District Court and occupied that position until 1891, when he retired from the bench, and he has since built up an extensive law practice. He continues, however, to take an interest in public affairs and is now president of the Board of Public Works of the city of Camden.

Recognizing at an early day the possibilities for investment in the electrical field, Judge Armstrong became interested in several electrical companies, and to-day he represents large financial interests in several electric light, power and street railway companies operating in New Jersey. He is president of the Camden Light & Heating company, the only electric lighting company of the city, and the Atlantic Electric Light & Power company of Atlantic City. He is also largely interested in street railways operated by electricity at Cape May, Camden, and other cities and villages throughout New Jersey. All of these corporations enjoy the confidence of the communities which they serve. This has been President Armstrong's policy. He has given the subject much attention, and he holds decided views on the relations which should exist between the public and corporations of a quasi-public character.

A lawyer by profession and a close observer, Judge Armstrong fully appreciates the necessity of retaining the confidence of the public in the ability and integrity of central station management. His utterances before the St. Louis convention and on former occasions have been in this line. He has advocated improved service as the best method of attracting the confidence and good will of the people. He believes, too, that central station companies have rights which the public is bound to respect, and which the managers of these corporations should enforce.

Personally the new president of the National Electric Light association is an agreeable gentleman, courteous and affable in disposition and withal dignified in manner. As an enthusiastic and energetic promoter of electrical prospects he is known to central station men throughout the country. He has been a familiar figure at conventions of the association and is recognized as one of the happiest speakers in the organization. He is a good parliamentarian, a ready debater and will undoubtedly be an excellent presiding officer. Under his administration it is to be hoped that new life will be infused into the association, that its scope of usefulness will be extended and that its influence will be felt in every part of the country.

Many matters of moment connected with their relations with parent companies must now be considered by central station managers, and, as in the settlement of the points at issue the association must play a part of no mean importance, a wise and conservative administration is more essential at the present time, perhaps, than at any period in the history of the organization.

E. A. ARMSTRONG.

Trip of the Chicago Delegation to St. Louis.

The Chicago delegation reached St. Louis on Tuesday morning and was greeted by a reception committee from the Electric club. The start had been made in a blinding rain storm, but when the party reached St. Louis they found a very decided change. The weather was all that could be desired. The arrangements for the trip had been carefully executed and the delegates had every convenience that modern railway service could afford. A compartment car, sleeper and buffet car had been placed at the disposal of the delegates by the Illinois Central Railroad company. The same arrangement was made for the return trip, and the members of the party expressed their appreciation of the services of Jesse Scribner, who had charge of the transportation from Chicago. There was much praise, too, for the excellent accommodations afforded by the Illinois Central Railroad company, and Mr. Bishop, the Chicago representative, was complimented upon the excellence of the service.

A Buffalo syndicate proposes to build an electric railway from that city to West Seneca.

St. Louis Meeting of the National Electric Light Association.

The convention of the National Electric Light association at St. Louis last week was a business meeting, and was well attended by central station managers and representatives of manufacturing companies and supply houses. The sessions of the convention at the Telephone building were well attended, and the tours of inspection to the electrical stations were thoroughly enjoyed. There are many interesting electrical features in and about the Mound City and these were fully appreciated by the visitors. Entertainment was provided for the delegates and their friends, and excellent judgment was displayed in the arrangement of the programme, so that the social features did not conflict with the business of the convention. This was a radical departure from some of the conventions in recent years, when the meetings of the association were only slimly attended on account of other attractions.

The convention hall had been handsomely decorated, bunting, flags and streamers giving it an attractive appearance. The effect was heightened by the incandescent lamps which were placed in every conceivable position. In front of the speakers' platform there were several standards on which were clustered numerous incandescent lamps in fancy shades. All of these served to illustrate the value of the incandescent lamp in decorative work.

At the opening of the convention the hall was crowded with spectators. Representatives of the best familes in St. Louis were present to welcome the visitors. Mayor Noonan's address voiced the sentiments of the people of the city, and the expectations of the visitors were not disappointed. The attendance at the other sessions of the convention was much larger than it has been in former years. Prof. Forbes of London, England, who read a paper before the convention, was an interested visitor, and there were many prominent American engineers in attendance. The feature of the convention which attracted the most attention was the lecture by Nikola Tesla on Wednesday evening. Exposition hall, which has a seating capacity of 5,000, could not accommodate those who wished to hear the distinguished scientist and witness his wonderful experiments. It was one of the most brilliant assemblages that St. Louis has ever known. The boxes were filled with ladies in elaborate costumes, and many of the gentlemen in the audience were in evening dress. On the platform President Ayer, Prof. Forbes and several prominent American electricians were seated. Mr. Tesla showed some very interesting effects produced by currents of high frequency, but it is to be regretted that his voice could not fill the hall, and many were unable to gather any intelligent idea of the lecture. At the close of the meeting an informal reception was given and the delegates were presented to Mr. Tesla.

Another interesting feature of the meeting was a presentation to Cyrus O. Baker, Jr., by the New York visitors. A handsome silver punch bowl and ladle suitably inscribed were presented on behalf of his friends by T. C. Martin in a few well chosen words. Mr. Baker responded fittingly and assured the members of his appreciation of the spirit in which the gift was made.

When the convention had adjourned Thursday evening the secretary, George Porter, was summoned by a messenger to appear before President Armstrong at the Southern Hotel. It was the first spare moment that Mr. Porter had had during the entire meeting, and his friends had taken occasion to testify their appreciation of his services by presenting him a memento of the St. Louis meeting in the form of a handsome gold watch. Judge Armstrong congratulated Secretary Porter upon the excellent work he

had done since his appointment and assured him of the esteem in which he was held by the members. Mr. Porter fittingly replied.

Trip of the New York Delegates to St. Louis.

Providence smiled on the New York delegates to the electric light convention. While the Chicago delegates in making the start had to resort to overshoes and macintoshes to keep dry, the New Yorkers left home in high spirits, with the sun shining brightly. Never was a jollier party gathered together. The special train engaged for the occasion consisted of four cars specially allotted for the convention, and the equipment was of the usual high class of the Pennsylvania Railroad company, and was, it is needless to say, all that could be desired.

About noon the delegates began to congregate at the station in Jersey City. All the passengers, though, were not delegates, for ladies made a good proportion of the jolly party. The Boston delegation which met the party at Jersey City was of course small, from the fact that many had taken a more direct route from Boston. The Philadelphians, however, when they joined the party, together with those picked up at Harrisburg, Pittsburg and other points, increased the number to 100. The first day out, to speak in the language of the voyager, was an uneventful one. On Monday, however, the fun began immediately after breakfast and continued unabated until the party reached St. Louis.

Indianapolis was reached about 2 o'clock in the afternoon. Quite a long stop was made at this point, and the time was pleasantly passed through the aid of an Indianapolis photographer. Several group pictures of the delegates were taken, and a large picture of the convention train was also made. After about half an hour's stop at Indianapolis the journey was resumed. Contrary to what might have been expected, the fun kept up even in the afternoon, and it may be said there was no unnecessary slumbering at any time on the convention train. The merriment continued until the train reached Vandalia. At this point the eastern party was met by the delegation appointed by the St. Louis electrical people to take care of the visitors.

The last named party—about a dozen in all—was rather surprised to receive a royal reception from the dignified easterners. They were literally "hustled" into the dining car, and once in there, they were entertained by the darky quartet that had been pressed into service for the entertainment of the easterners in the forenoon. Time passed very rapidly, though, and hardly before it was realized, the call "St. Louis!" was heard. Everything had been done for the delegates that could be possibly thought of to make their way easy. Special buses had been provided, and the entire party was taken without delay to the Southern Hotel.

Too much credit cannot be given to H. M. Haines, passenger agent for the Pennsylvania Railroad company, in whose care the party had been placed. Everything had been done to make the long journey as pleasant as possible. To show their appreciation of the courteous manner in which the party had been treated by the company, Mr. Haines was given a vote of thanks as a public expression of the party's obligation. A word, too, must be said about the efforts of C. O. Baker, the National Electric Light association's master of transportation. No one who has not engineered or helped to manage a convention train can thoroughly appreciate the arduous nature of an amateur master of transportation's duties. Of course, Mr. Baker had last year's experience to aid him, but it need only to be said that there are easier positions in the gift of the National Electric Light association than that which was this year filled so efficiently by Mr. Baker. In arranging for the train, there were a number of difficulties that had to be overcome and provided for, and many were the kind words of the convention party as to the successful manner in which the party was brought through to St. Louis.

Another Central Station Fire in Buffalo.

Buffalo seems to be particularly unfortunate in the matter of central station fires. Only a few months ago there was a serious fire in the Court street station, and on February 25th the Elk street station was damaged by fire to the extent of $20,000. A large portion of the arc lamps used for street lighting were supplied from this station, and considerable inconvenience resulted from the fire in consequence. The news of the misfortune was conveyed to the St. Louis convention by a telegram from ex-President Huntley, giving the fire as the reason for his absence. Much regret was expressed by the members of the association, who are all friends of the popular Buffalo manager.

THE CONVENTION

Of the National Electric Light Association at St. Louis.

The sixteenth convention of the National Electric Light association was held at St. Louis, February 28th, March 1st and 2d. President Ayer called the meeting to order, and introduced the Hon. E. A. Noonan, mayor of St. Louis, who welcomed the delegates as follows:

ADDRESS OF WELCOME.

"In the four years of my official term I have had occasion to address bodies of gentlemen representing in convention the great forces, I might say, of modern civilization; but at no time have I had the pleasure of addressing those concerned in what to my mind is now the greatest, the most wonderful, the most far-reaching, of all forces known to man—electricity. I represent the people of St. Louis. On this occasion especially has the public press announced, and in a hundred different ways it has come to me, that so far as this particular convention is concerned, St. Louis will outdo herself in making life pleasant and agreeable for the gentlemen who have come here to deliberate upon these important matters. This is the most important convention, in my humble judgment, that St. Louis has ever had; not in numbers of delegates, not in the great acclaim that has attended your arrival, but in the light of what you represent, in the sense of what will be accomplished by reason of your sessions here. The city of St. Louis is your's, your wife's, your daughter's and your sweethearts', if you have any with you."

President Ayer then introduced Robert McCulloch, president of the St. Louis Electric club, who reiterated Mayor Noonan's welcome and assured the visitors that the electrical people of St. Louis would do everything in their power to make the visit a pleasant one.

President Ayer read his annual address, which is presented on another page. At the conclusion of his address, the president declared the sixteenth convention of the National Electric Light association formally opened.

The president announced that the burning of one of the largest stations under the management of ex-President Huntley, at Buffalo, had made his absence imperative, and read a telegram expressing his regret.

The paper by A. D. Adams on "Wrought versus Cast Iron for Field Magnet Frames" was read by Vice-president Armstrong.

The secretary made several announcements. Letters of regret were read from Prof. Henry T. Bovey, Montreal, Canada, and Prof. E. L. Nichols, Ithaca, N. Y. Letters of invitation to participate in courtesies were read from the Merchants' Exchange, St. Louis; Bell Telephone company, St. Louis; Pastime Athletic club, St. Louis; Knapp-Sellner Chandelier company, St. Louis. An invitation from Hon. C. F. Bemis, mayor of Omaha, to hold the next meeting of the association in that city was read. The letter was referred to the proper committee, and the former were accepted, with the thanks of the association. The president announced that there would be open house at the Electric club at all times of the day and night, where a buffet lunch would be served, and where all in attendance at the convention might resort at any time. The president read the programme of entertainment provided by the local committee.

Mr. Armstrong then read the report of the committee on the World's Fair, the chairman, B. E. Sunny, being absent.

REPORT OF THE WORLD'S COLUMBIAN EXPOSITION COMMITTEE.

The Paris Exposition of 1881 was lighted in part by 1,383 arc lights, and was the first arc lighted exposition.

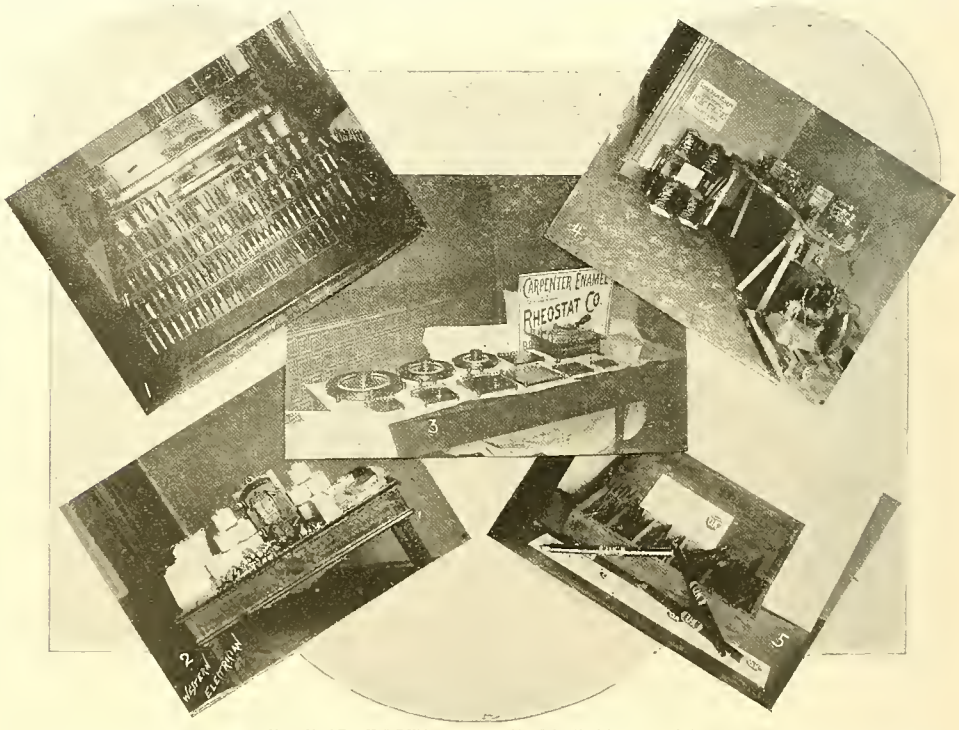
The Louisville Exposition of 1882 was lighted by 5,000 incandescent lights of sixteen candle power each, and this was the first use of incandescents for exposition lighting. The New Orleans Exposition was lighted by both arc and incandescent lights.

The Paris exposition, of 1889, made the largest use of electricity up to that time. There were for public lighting service 1,093 arcs and 8,837 incandescents.

For private lighting there were used 623 arcs and 4,010 incandescents. The total of the service installation aggregated 3,125 horse power capacity, and with small installations, the grand aggregate capacity reached nearly 4,000 horse power. There was practically no use made of electricity as a motive power.

The World's Columbian Exposition has placed contracts for 4,500 arc lights, of 2,000 nominal candle power each, and received donations from miscellaneous exhibitors of about 700 additional. It has placed contracts for about 80,000 incandescent lights and received donations as special exhibits of about 10,000 additional. It has placed contracts for 2,900 horse power capacity of power generators and received donations of 1,600 horse power capacity.

It has made contracts for electrical fountains requiring an installation of 900 horse power capacity. The aggregate of power generators and fountain plant (the latter will be used particularly for charging the storage batteries of the electric launches) is 5,300 horse power.



VIEWS OF EXHIBITS AT THE ST. LOUIS CONVENTION.

1. Phillips Insulated Wire Co., New York.
2. Taylor, Goodhue & Ames, Chicago, and the Campbell Electrical Supply Co., Boston.
3. Carpenter Enamel Rheostat Co., Bridgeport, Conn.
4. Electric Selector & Signal Co., and C. & C. Motor Co., New York.
5. Norwich Insulated Wire Co., New York.

The aggregate of the electrical installation therefore amounts to 19,500 horse power. The aggregate of bogiler capacity employed is 18,000 horse power on the standard rating of 30 pounds of steam per horse power. With such efficiency as should be expected from the engines installed, this represents an effective total of about 24,000 horse power.

The most interesting point of this plant will be the use of oil as a fuel. From the time the crude petroleum is emptied from the railroad tank cars into the World's Fair storage tanks, at the extreme southeast corner of the grounds, this oil becomes part of the power plant, the pressure upon the delivery pipe being automatically controlled by the steam pressure in the boilers. Delivery to boilers is made by pipes laid underground from the storage tanks to the boiler house, and the oil introduced into the furnace through an atomized jet.

A point of exceeding interest in the engine and dynamo room will be the very large adaptation of dynamos to Corliss and medium speed types of engines in direct connected combinations. The largest of these will be a set of vertical triple expansion engines with two connected armatures. At 160 pounds steam pressure this single unit will give most economically 1,200 horse power, with a capacity for continued service of 1,500 horse power output.

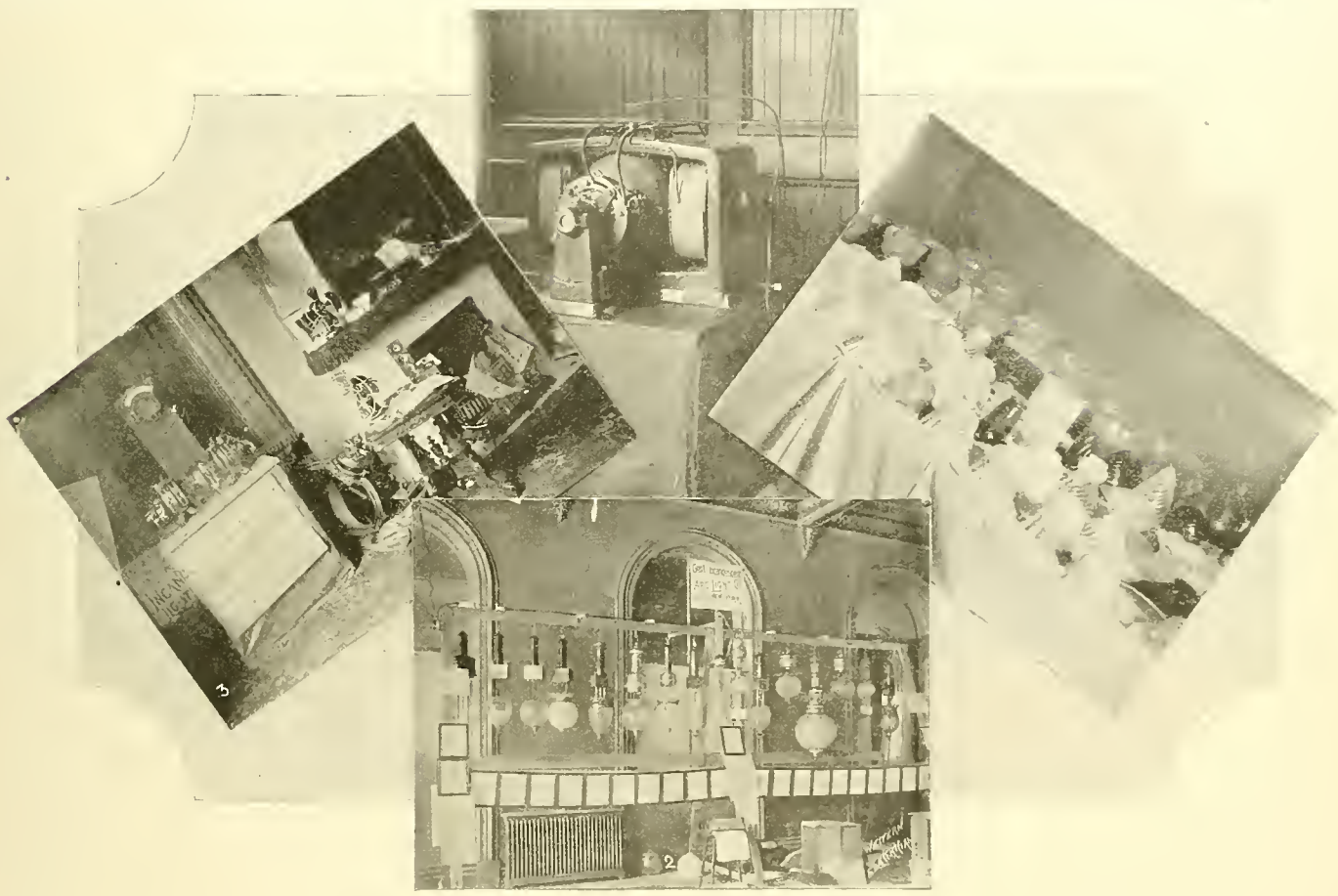
Next to the universal distribution of electric power for all points of the grounds, the most marked advance of the time is the application of electricity to the transportation service of the exposition. This service will be by a three mile double track elevated railroad following all the precedents and best practices in block signaling systems, power brakes and all other safeguards of the modern steam railroad used in exclusive passenger traffic. The entire operation will be, however, by electri

power drawn from an independent power plant of more than the aggregate capacity installed at the Paris exposition. In this power house will be found the latest examples of the large range of direct driven power generators, five in number and aggregating 3,500 horse power capacity.

To those who have not had an opportunity of informing themselves of the part that electricity is expected to play at the exposition these figures will be interesting and will indicate to all how much greater by comparison with preceding expositions the Columbian exposition is bound to be.

The sensational reports telegraphed from New York that many of the prominent electrical firms in that state had decided to abandon the space allotted to them and make no exhibit were found on inquiry to be based on the fact that three small concerns had gone out for reasons that were personal to them. Every foot of space in the great building has been taken and every electricial concern of any consequence in the world will be fully represented.

The active work of preparing for the exhibits has been going forward for some weeks and many of the electrical firms have made substantial progress in the erection of their booths.



VIEWS OF EXHIBITS AT THE ST. LOUIS CONVENTION.

1. Eddy Motor Co., Windsor, Conn.
2. General Incandescent Arc Light Co., New York.
3. Interior Conduit & Insulation Co., New York.
4. James J. Murray & Co., Philadelphia.

The intellectual programme under the auspices of the World's Columbian Auxiliary, promises to be of remarkable interest. As you know, Prof. Elisha Gray is at the head of the electrical branch and he now has assurance that the gathering of electricians from all parts of the world will be a grand one.

At the conclusion of the reading of the foregoing report the meeting adjourned until 2 o'clock.

At the afternoon session Captain William Brophy read his paper on "Relation of Insurance to Electric Lighting and Power." This subject has received the attention of central station men and capitalists probably more fully than any other topic. It revived the old question of rules for safe wiring and provoked animated discussion, which, together with the paper, is presented on another page. In the course of the discussion Prof. Weston made an interesting address in response to several inquiries which were made by the members.

The next order of business was the reading of the paper by R. H. Sterling on "Some Experiences with the Alternating System." This paper was also fully discussed.

Wednesday's Meetings.

On Wednesday morning when President Ayer called the meeting to order the hall was filled. During the night and early in the morning several delegations from distant points had arrived. The proceedings were the most interesting of the entire convention. Prof. George Forbes of London, Eng., read a paper on "Thermal Storage for Central Stations." The subject was thoroughly discussed and it proved a relief after the cut and dried opinions on the old topics that have been before the conventions of the last four years. The entire morning session was devoted to this discussion and was the most enjoyable feature of the program.

In the afternoon Charles S. Bradley of Rochester, N. Y., read a paper on "Long Distance Transmission of Power," and Dr. Louis Bell followed with an admirably prepared paper on "Power Transmission for Central Stations." The third paper of this series was that of L. B. Stillwell of Pittsburg, whose subject was "Under What Conditions Is the Use of Water Power Economical?" A general discussion of the subjects considered in these papers occupied the afternoon session, and the interest was maintained throughout. When the discussion was finally closed the president presented an invitation from the Seigel Gas Fixture company to visit its establishment at 219 North Broadway; also an invitation from Henry Sylvester to inspect at 113 Chestnut street a model of a special type of underground subway. A communication was read from the Columbian Underground Electric Traction company inviting the delegates to inspect a new street railway underground conduit. An invitation was received from the St. Louis Car company to examine a new model president's car constructed for the New Orleans street railway system, costing about $9,000, and at the same time offering the use of carriages to convey such of the members as signified a desire to examine the car mentioned.

Thursday's Meetings.

On Thursday the convention was called to order at 10 A. M. by the president, who announced, that any of the members of the association who might desire to visit any of the theatres of St Louis would be provided with tickets for that purpose upon application to the secretary. The first order of the regular business of the day was the reading of a paper by W. H. Browne of New York upon "Underground Conduits and Conductors." Mr. Browne was not present, and the president called upon William J. Hammer to read the paper for him. The reading of this paper was followed by a tedious discussion, in which several of the members reiterated views that have been advanced at every meeting of the convention since the subject was first brought into prominence. The discussion, moreover, was not confined strictly to the subject of the paper, and it became necessary for the president to call the attention of several members to the fact that they were digressing from the topic under consideration. Finally T. Carpenter Smith won the applause of the members and visitors by suggesting that the discussion be closed immediately. He said: "I do not know how other members of the convntion feel, but I have attended seven or eight meetings in which this matter has been thrashed out until all the grain was out of it and nothing left but the straw. You can read over the last five printed reports and find that all this has been gone over time and again. You can read them at home and save a great deal of time here. We do not want to go underground if we can help it, and the best way to stave it off is to do good overhead work. But leaving all that aside I say that the thing has been gone over thoroughly, and I move that the discussion close." This motion was almost unanimously adopted, and the convention then proceeded with other business.

Calvert Townley read a paper on "The Incandescent Lamp from a Commercial Standpoint," at the conclusion of which the morning session was adjourned. In the afternoon, however, this subject was called up for discussion which proved rather spirited. The relations of the central companies to the parent concerns was introduced station and finally the matter was referred to the committee on "Relations Between Manufacturing and Central Station Companies." Prof. Weston made an interesting address, in which he traced the progress of the incandescent lamp since its introduction to the commercial world.

H. C. Meyers paper on "The Vulcanizing Process for the Preservation and Strengthening of Poles, Cross Arms, Ties, etc." and the paper of E. A. Armstrong on the "Morals of Corporations," were read.

The following resolutions, presented by Mr. Armstrong, were unanimously adopted:

Resolved, That the sincere thanks of this association are due and are hereby tendered to the citizens of St. Louis, the Electric club, the Electrical Exchange, the Bell Telephone company, and the city press for the very full reports, as well as to many others for the very elaborate courtesies they have extended to us, which have rendered our stay here so exceedingly pleasant. We have discovered that the kind proffer of His Honor, the Mayor, in his welcoming address, has been liberally realized—"St. Louis and all that she has is ours."

Resolved, That we extend as an association, and individually, our thanks to our esteemed president, James I. Ayer, for the ability and courtesy with which he has discharged the responsible official duties of his position. As individuals we want to put on record the fact that from our experience in St. Louis at this convention we have learned that his affability is perfectly generated, is of the highest efficiency, the lines are innumerable and are all overground; the current is sent out without a drop or flash, and on these lines there is no switch board, throw-out, cut-off or arrester, and against its power no amount of trouble has been able to act as an insulator.

President Ayer responded to the resolution and expressed himself pleased to know that the delegates had been so well provided for, and said that he, in turn, was indebted to the citizens of St. Louis for the earnest efforts they had put forth on this occasion. He thanked the gentlemen for the attention they had given to the meetings of the association. At this point the regular sessions closed, and the association went into executive session.

An interesting feature of the afternoon was the passage through Tenth street of the vehicles used in the service of the Municipal Electric Light & Power company, of which Mr. Ayer is general manager. The procession consisted of the superintendent's light wagon, pole wagon, dynamo wagons for the handling of heavy machinery, linemens' wagons, trimmers' carts, inspectors' carts, line repairers' carts, metermen's carts, and one or two other kinds of carts the whole aggregating about eighty.

In the executive session the secretary's report was read, which showed the association to be in a good finan

cial condition. There were thirty-one new active members gained during the year, and the total membership of all classes is now 250. Nikola Tesla and James I. Ayer were elected honorary members of the association.

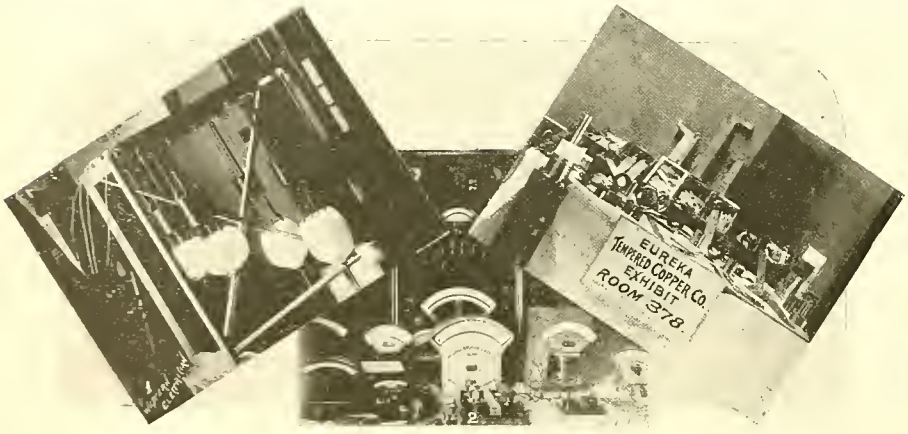
An invitation was given by Dr. E. C. Kilbourn of Seattle, Wash., for the association to meet at that city next year. Dr. Kilbourn said that the expense of every one in attendance at the meeting would be paid by the citizens of Seattle.

The following were elected the officers of the association for the ensuing year: President, E. A. Armstrong, Camden, N. J.; first vice-president, M. J. Francisco, Rutland, Vt.; second vice president, C. H. Wilmerding, Chicago, Ill.; secretary, George F. Porter, New York, New members of the executive committee: J. A. Seeley, New York; E. F. Peck, Brooklyn; A. J. DeCamp, Philadelphia; W. A. Morrison, Woodstock, Ont.; H. J. Smith, New York; G. H. Blaxter, Pittsburgh.

The place for holding the next meeting was referred to the executive committee.

Incandescent Lamp Question.

It was expected that the incandescent lamp litigation and the attitude of the General Electric company toward rival lamp companies and central stations would be discussed at the St. Louis convention, and those who anticipated a lively debate were not entirely disappointed. Throughout the convention the subject had been discussed—in the hotel corridors and wherever a group of members could be found the principal topic of conversation was the lamp question. It was generally believed that the meeting would not close without some expression on the part of the members, if, indeed, the association was not placed squarely on record. When the last session of the convention was called to order on Thursday afternoon the hall was crowded with anxious lamp men, supply dealers and central station managers. At this meeting the discussion on Mr. Townley's paper on the "Incandescent Lamp from a Commercial Standpoint" was taken up, the most interesting part of the proceedings began.



VIEWS OF EXHIBITS AT THE ST. LOUIS CONVENTION.

1. Fort Wayne Electric Co., Fort Wayne, Ind. 3. Eureka Tempered Copper Co., North East, Pa.
2. Weston Instrument Co., Newark, N. J.

T. Carpenter Smith said there was one matter which he felt it was his duty to bring before the association. He knew it was a subject which would be differently viewed by different persons, but he hoped that in the discussion of it no violent opinions would be expressed. Nothing was to be gained by employing immoderate language. The courts had given to one company the monopoly of the incandescent lamp business, and it made no difference what the equity of the case might be, although the courts in their decisions had shown what even they thought of the equity of the matter. His company was in the fortunate position of having been established before July, 1891, so it was entitled under the court's decision to the privilege of purchasing lamps. Fortunately his company was not compelled to buy more than a few lamps, for it had made it a policy to have customers make their own lamp renewals. He believed this to be the better system. There were, however, some old customers with whom contracts once made were still in force, and for them it was necessary to buy lamps. After the monopoly had been established he had gone to an authorized official and stated that he wanted to buy other lamps than the Edison, for within the limit of his experience the Edison lamp was the poorest. He was willing to pay 15 cents for a Thomson-Houston lamp rather than 35 cents for an Edison lamp, but he was met with a flat refusal to allow him to secure anything but the Edison. He was willing to use the the Beacon lamp, the Sunbeam, the Perkins lamp or any other and pay an extra price for it, but he could not do so. Here was a matter that came home to the central station man, and he thought this was a matter which should properly be brought up for consideration. How was this practice, which he deemed unjust, to be fought? That it was to be the policy of the General Electric company, he knew. He had been informed by a gentleman high in the counsels of the General Electric company, that it was not its purpose to allow other lamp companies to manufacture under royalties, but that the business belonged to it and it proposed to have it. He thought an equitable plan would be for the company to insist on a royalty of say ten or fifteen cents, so that while the Edison lamp would be so'd for thirty-five cents the others would cost forty-five or fifty. Then these manufacturers would be compelled to make their lamps good and improvements would follow. Better lamps would be the result, and that was what the central station man wanted. Did any believe that the transformers today would be so efficient had not manufacturers been brought into rivalry in this way? As for himself he did not propose to buy a dollar's worth of goods of the General Electric company so long as it pursued its present policy in this respect. In conclusion he said:

I do not think there is a central station man who wants to swindle the General Electric company or the Edison company out of anything that the law gives it. These companies have spent a great deal of money to get this monopoly and there is no reason why they should not be sustained in it; but I do not think that they should tie us down to using something we do not want. It seems to me that the whole equity of the case would be met if the General Electric company did as it very plainly hinted it meant to do; that is, that it would license the several lamp manufacturing companies and charge a royalty. If it will do this I will have no objection. I am perfectly willing to pay ten cents a lamp more for any of about ten different kinds of lamps rather than use the Edison. We want the best lamp, and the best lamp will, of course, in the end be the cheapest. I shall do all in my power to advance the sale of any lamp which is put on the market which can be manufactured without coming under the law of infringement.

W. S. Howell of Newark, N. J., said he wished to take exception to Mr. Smith's statement that the Edison lamp was the poorest on the market. He was immediately corrected by Mr. Smith, who said that he had been careful to state that the Edison lamp was the poorest merely within the limits of his experience. Continuing, Mr. Howell said he had within the last few years investigated the causes of complaints of Edison lamps. In no case had he found that the trouble lay in lamps; it was the fault of the pressure of the system on which they were used. It was a well known fact that an excess of 3 per cent. in the current shortened the life of the lamp 50 per cent. It was just here that trouble had been found with Edison lamps. He thought central station men should look out for the pressure, and should purchase a three watt lamp, a four watt lamp or a six watt lamp in accordance with the requirements of the service.

Dr. Louis Bell said that the fact that his connection with a certain company did not influence him in the view which he took of the matter. First of all he was a member of the National Electric Light association, and he spoke solely in that capacity. He did not think the matter should have been brought up in the meeting. He considered it a matter of discourtesy and bad form. He did not believe that the association should be used as a cat's paw to pull commercial chestnuts out of the fire. He wished to know if the gentleman believed that a certain company should break the solemn compacts made with local companies. How would he feel if a solemn obligation with him had been disregarded? He also wished to add that this attack came with very bad grace from a man whose name appeared in an endorsement of another company's apparatus in an article ending with three stars, which all newspaper men, at least, knew signified a paid advertisement.

Mr. Smith said he supposed the previous speaker had referred to him. He wished to disclaim any knowledge of what Dr. Bell had insinuated. He had never refused to put his name to an article when he thought the article was worth signing, nor had he ever been paid for the written endorsement of any kind of apparatus. He demanded an explanation.

Dr. Bell said if an unauthorized use of Mr. Smith's name had been made then his own remarks were uncalled for.

President Ayer said the discussion was assuming a personal character and he should be obliged to stop it. He suggested that the matter might probably be disposed of by referring it to the committee on the relations between central stations and parent companies.

Mr. Smith rose to a question of privilege and asked Dr. Bell to withdraw the statement.

President Ayer said it seemed to him that Dr. Bell had practically done so by saying that his remarks were out of place if the use of Mr. Smith's name was unauthorized.

A. J. DeCamp moved that the matter be referred in accordance with the president's suggestion, and this action was taken. Mr. Smith again rose to a question of privilege and asked Dr. Bell to name the article to which he had referred, and the paper in which it had appeared. Dr. Bell handed him a copy of the *St. Louis Republic* of March 2d. This paper on the twelfth page contained an advertising reading notice under the caption "Westinghouse the Best." In the course of the article was a paragraph purporting to be an interview with Mr. Smith. It read as follows:

T. Carpenter Smith of Philadelphia: "The Missouri Electric Light & Power company has one of the finest central station plants in the country. It is simply perfection, and while the management of the company deserves great credit for the manner in which they operate their plant, it must not be forgotten that were the plant installed with any other than the Westinghouse alternating system of electric lighting apparatus the company would not be so successful as it is."

Mr. Smith, after reading the article, said it belonged to the order of faked interviews. As for himself he had been confined to his room by sickness during the evening and was not responsible for it in any way. He thought Dr. Bell should withdraw the statement.

Dr. Bell rose and said that, now realizing that the use of Mr. Smith's name was unauthorized, his remarks had been uncalled for.

President Ayer then addressed both Mr. Smith and Dr. Bell and said he hoped that there would be no cessation in their friendly relations as a result of this insignificant incident. They both protested that they considered it of no consequence.

The Nomenclature Discussion.

Considerable attention has been attracted in Europe by the proposed reform in electrical nomenclature at the World's Electrical Congress in Chicago in August. *Industries* of London has this to say on the subject:

The American Institute of Electrical Engineers is prepariog for the Chicago Congress. It wants a unit of "magneto-motive force," and one of "magnetic intensity," which appears to be induction. "Magoetic reluctance" is, fortunately, preferred to "magnetic resistance;" it is a pity that it adheres to "magneto-motive force" for a quantity which is not a force but a potential. The members of the committee also speak of the "meter candle" and "foot candle," when they mean candle per square foot or square meter. "Current strength" appears for "current." Attention is called to these points, which would in ordinary circumstances be trivial, because in connection with the International Congress scientific accuracy is of the first importance. With most of the recommendations electrical engineers in this country will cordially agree. "Voltage" is really a barbarous word, which is quite unique in its termination, and is therefore unsystematic. 'Diphase" and "triphase" are common, but inaccurate. Why not double-current and triple-current? The exact meaning of the word "phase" is seldom understood. In America electricians talk of alternators being "out of phase," and so on. The word comes from astronomy. If a planet had two or three satellites we should not say they were diphased or triphased; we should say there were double or triple satellites, or two or three of them. It is thus simpler to talk of double and triple currents. We shall probably return to the subject of electrical nomenclature before the summer comes upon us, as we fear by the autumn most of our readers will be very tired of it.

Telephone Litigation.

The American Bell Telephone company appeared in the United States Circuit Court at Boston on February 24th and asked Judge Nelson for further time in which to file testimony before the examiners appointed by the court to take testimony in the suit of the United States against the telephone company and Prof. Bell, in which the defendants are charged with obtaining a patent by fraud. The suit has been in the court about eight years, and an exceedingly large amount of testimony has already been put in by both sides. Judge Nelson granted the request and gave the petitioners until August 25th to complete their case.

President Ayer's Annual Address.[1]

At this, our sixteenth convention, it gives me much pleasure to receive you in a city which can display such an appreciation of the work in which we are engaged; to welcome you in my home and be able to present to you the attractive programme that has been prepared.

Since the first meeting in 1885 at our sister city by the lakes, we have spread upon our records evidence of the wonderful progress of the great industry which we represent, and while as measured by time the years are few, the progress is marvelous. No art, no industry, no science can compare with it; and in no more forcible manner can it be presented than by stating that there is more capital invested in St. Louis in the application of electricity to day than the sum total of investments throughout the United States for the production of apparatus and its use when this association was born. These are facts well known, yet hardly realized by those of us who are engaged in promoting this remarkable development. In St. Louis we have installed 266 dynamos, in central station and private plants, supplying current to 185 000 incandescent and 5,330 arc lamps; a total of 1,800 horse power capacity of generators supplying 660 motors for operating almost every character of machinery, and 8,240 horse power in generators, operating 1,126 street car motors, over 160 miles of road; and the roads under construction, to be completed within the year, will add 8,000 horse power in capacity and 96 miles of road. This will make a total generating capacity of 30,000 horse power.

There are nearly sixty square miles of territory supplied with arc and incandescent lights, crossed and recrossed with electric roads. The changing from steam and cable to electricity for motive power has transposed a bankrupt road into a most valuable property, and successful cable roads are to be changed at much expense to electric, that they may be more successful.

Since our last meeting much has transpired of interest to the members of the association. Important developments have been announced from time to time through the press, as a result of the work of inventors, and many valuable items of detail have been brought out to add to the efficiency and satisfactory working of existing apparatus. The commercial development, however, has been confined to improvements in well known apparatus and not to radical departures in character of generators as many were led to expect a year ago. More light will doubtless be given us in this direction through some of the papers we will be favored with; but there seems to be little likelihood of the immediate introduction of new methods which will affect the quality of investments in existing apparatus, though there is reason to expect in the very near future that which will likely solve the problem of long distance transmission in a satisfactory manner. The much desired power motor for simple alternating circuits we are still anxiously looking for, and for some applications such motors as are known to be practical should be produced.

The recent patent decisions have introduced a new condition to many, brought anxiety and trouble to some and satisfaction to others. To those of us who were lulled into security by the tedious delays of the courts and the persuasive arguments of our friend, the salesman, who had so many advantages to offer, comes anxiety. To those of us who have only recently entered the field and who heard very little of claims for "foundation patents," it is a new condition we can hardly realize and we doubt its reality; and we are strengthened in our doubt by those who don't want it so. To those of us who considered carefully and believed in the ultimate establishment of the inventor's claims and rights, and who gave evidence in support of this faith by paying, in addition to a fair market price for the apparatus, an additional sum for the right to use it, and who have waited many years to receive the protection we paid for it, comes the feeling of satisfaction.

That such a condition as exists to-day is possible calls for prompt action, that the rights of the people may be better protected. That the inventor can be so long deprived of his rights that many are led to believe by the delay that he has none, and to such an extent that millions are invested in developing a business made possible by his invention, without regard to his claims, is clear evidence of the need of reform in our laws which will provide adequate protection for the investor as well as the inventor; and we earnestly recommend some action on the part of this association, that our properties, which have been so long regarded with distrust and suspicion by the financial world, may not have added to their burdens the question of their right to use devices which are vital to their success; and to so place the station manager that he must not add to his other essential qualifications that of being able to divine what the courts may do in the far future. At previous conventions this topic has been considered and efforts made to have Congress take such action as would give relief. Work in this direction should be taken up again by this body and vigorously pushed to completion.

I note with much pleasure that since our most interesting and delightful visit to Montreal, most rapid advancements in electrical interests have followed, and that the Canadian Electrical association has at a recent meeting given much evidence of remarkable growth. This, with the greatly increased business of our electrical manufacturers, notwithstanding the protection wall over which their "heavy" products have to be lifted, indicate that our time was well spent; that there was developed a friendlier feeling and closer intimacy, besides giving an impetus to electrical development for which they seemed to have been waiting. I believe our visit has done much to hasten the time when there will be no wall between one country and one people.

The preparation for the World's Fair is rapidly nearing completion, and in a few short weeks there will be open to the visitor one of the most magnificent achievements of modern times—an engineering and architectural wonder. In no particular is it more remarkable than in the department of electricity. This in its ramifications permeates all departments and will make possible most marvelously beautiful effects, as well as prove the most useful of servants. Too much praise cannot be awarded those who have labored to produce this most complete exposition of the development of the science in all its forms.

The American Institute of Electrical Engineers is doing much to assist in the arrangements for a fitting meeting of the electricians of the world, and our committee will present a report which will enable us to act in the best manner to show the national and patriotic character of our organization.

In the last year much work has been accomplished by our secretary, and the showing for the year will, I feel, be very satisfactory when his report is read. Three volumes of the association proceedings have been edited, published and delivered to members within the year, bringing this work down to date. Because of the accumulation and the large amount of matter contained in each volume this has been no small task, and the creditable results obtained in the handsome volumes, together with the thorough manner in which the office has been conducted, make it but a simple act of justice that I express my thanks and commendation at this time.

The interest in the proceedings of the convention evinced by the educational institutions throughout the country is one of the encouraging signs of the times, and justifies the statement (which is evidenced in many other ways) that the power and influence of the association are extending. The increase of membership is flattering. With this condition existing there will come up for your final consideration the question relative to the reduction of dues. While present conditions indicate that we can with safety reduce our dues, and possibly increase the membership beyond its natural growth under the present rate, yet there is much work which can be carried out to the benefit of the association which would have to be neglected if our revenue is reduced. The dues at present are hardly a burden, and a balance on the right side of the ledger is essential to the prosperity of any institution. While a change in the dues would not effect our treasury for more than a year, I do not think it wise to reduce them at present. This question, I trust, will receive due consideration before action is taken.

From the beginning until to-day every producer and operator in the electrical field has been before him the serious problem of how to get men sufficiently skilled to execute in a satisfactory manner the duties assigned them. Undoubtedly this business has attracted all departments the most ambitious elements from other lines of work; but, as we can all testify, their education in the new field has been enormously expensive to their employers. But the outlook is promising. Within the last three years there have been established more rapidly than ever clubs, societies, trades guilds and labor organizations with the principal avowed object of self-education. Their objects and efforts in this line are to be commended, and form a pertinent topic for this body to consider. In St. Louis we have, among societies of this class, an organization known as the Electrical Exchange, composed principally of contractors whose particular business is to do the electrical construction required in all modern buildings. Their prime object in organizing was that the execution of this work might be confined to those who were responsible and maintained regular establishments. Their endeavor is to so execute the work intrusted to them that they may command the respect and confidence of the central station manager, owner, architect and builder. To this end they meet for discussing improved methods and such other matter as may be suggested and calculated to [illegible] of mutual benefit. Insurance inspectors, supply houses and central station companies are eligible to membership. In contact with them we find them ever ready to co-operate with us in any movement to improve the service and increase the satisfaction of our customers; and since their organization a much better feeling has been established and the quality of work greatly improved.

Within the last year has been organized the National Association of Electrical Workers, with headquarters in this city, and having branches in many towns and cities. This organization is largely composed of linemen, though it expects to embrace in its membership electrical artisans or workers in every department. Their principal objects as stated in the first number of their journal, is to band together for mutual education and improvement; to establish rooms and provide instructors, and adopt such other methods as may improve the standard of electrical labor. This organization is capable of accomplishing a vast amount of good, if maintained on the high plane outlined. If the effort is earnest and honest we can all lend it a helping hand, and will do it gladly. The wage question will never be an element to make a breach when the rank and file of electrical workers have mastered their business. But until that time arrives those who are among them as leaders should keep in mind that satisfactory work performed in a conscientious manner is the first essential to pleasant mutual relations between the employer and the employed, as well as the strongest lever to raise wages that can be produced. Thoughtful care on the part of the manager must be given that the man who climbs the pole to clear a ground or close a circuit in the sleet and rain, and all others as well, be protected by all safeguards in the way of instructions and appliances that can be suggested. The engineer, the dynamo tender, the lamp trimmer, all must be encouraged in their efforts to improve in knowledge, by active co-operation on the part of the management. A close acquaintance with our employes is an essential to a full appreciation of their services. Many acts of real heroism are performed by the lineman or the dynamo tender, only that the service may not be interrupted, and that many times without a passing comment. We can shake out the crosses and clear the grounds by a closer acquaintance with our men and their work.

VIEWS OF EXHIBITS AT THE ST. LOUIS CONVENTION.

1. Washburn & Moen Mfg. Co., Worcester, Mass.
Falconer Manufacturing Co., Boston.
Chapman Valve Manufacturing Co., Indian Orchard, Mass.
Bryant Electric Co., Boston.
Geo. Cutter, Chicago.
2. Cutter Electrical Manufacturing Co., Philadelphia.
3. The Chas. E. Gregory Co., Chicago.
Ansonia Electric Co., Chicago.
Sperry Electric Mining Machine Co., Chicago.
Hart & Hegeman Manufacturing Co., Hartford.

We have for consideration a splendid list of papers which is varied, and yet devoted to topics which I trust and believe will develop that interest which will bring members to their feet in thoughtful discussion. The discussion of the papers and such topics as may come before you, I trust will receive the usual dignified treatment and earnest interest which has always obtained in this body.

During the year that has passed, death has claimed an unusual number whose names have been prominently identified with the active promotion, development and application of electricity in its various branches. Those particularly interested in the department devoted to telegraphy were: Cyrus W. Field, Wilson G. Hunt, F. M. Gisborne, Jay Gould and Norvin Green. In electric lighting and railways: C. J. Van Depoele, E. T. Lynch, Jr., M. M. Slattery; and in Europe, Werner VonSiemens. In this list are the names of those who have borne much of the heat and burden of the day and were among the few pioneers who hewed the path and assisted to broaden the road, by overcoming difficulties which we, who find it so comparatively smooth to day, little appreciate.

To our guests who have assembled with us and honored us by their presence, and who will further honor and instruct us with their words of wisdom, I want to express our thanks, and I trust that the members will, by their presence at the sessions, demonstrate the sincerity of this expression on their behalf.

1. Convention of the National Electric Light association at St. Louis, February 28, 1893.

The Incandescent Lamp from a Commercial Standpoint.[1]

By Calvert Townley.

All modern commercial forms of electric incandescent lamps in this country are similar in that each produces light by heating to incandescence a hard carbon burner of comparatively high resistance, enclosed in a glass receiver from which the oxygen has been largely exhausted. We know that after a time a burner so heated gradually depreciates, either by disintegration, oxidation, or some other cause, and is finally destroyed. We know that of two similar burners that raised to the higher temperature will require less energy per unit of light produced, but that its depreciation will also be more rapid and its destruction take place sooner. Consequently, in determining the temperature at which a carbon should be burned to secure the best economy, we are influenced to use a high temperature on account of the first condition, and a low temperature on account of the second condition.

There may be said to be other causes, due to differences in the design and construction of various lamps, which will affect the length of the lives of their burners, but it seems fair to assume that by the employment of proper methods, these causes may be eliminated in so far as they hasten depreciation in one carbon more than in another, and, therefore, in discussing the relation between the life and efficiency of different lamps, we may consider simply the characteristics of their burners.

For convenience in discussion, we may divide the commercial lamp burners into three classes, viz.:

1st. The untreated or natural burners used in the Edison lamps.

2d. The treated or flashed burners used in the Sawyer-Man, Thomson-Houston, Beacon, and a number of other lamps.

3d. What we may call the super-treated burners used in the new Westinghouse stopper lamps.

In all published tests of the life of burners there is shown to be a definite relation existing between the life of a carbon and the temperature at which it is burned, this relation remaining fixed for carbons of the same kind and varying only for carbons of different kinds. If we formulate this relation, it will assist us to determine what temperature of any kind of carbon may be expected to yield the best commercial results; that is to say, how much money it is desirable to spend on the maintenance of the carbon, and how much on the energy to heat it. The temperature of a burner is difficult of measurement. It will, therefore, be simpler, and quite as satisfactory, if we consider the relation between life and energy consumed, expressing the latter in watts.

By a series of experiments, extending over several years and covering tests of many thousand lamps, Frank Stuart Smith has found the relation between the life and efficiency of the Sawyer-Man carbons, and through his courtesy I am permitted to give you the results. The relation is expressed by the curve *A*, illustrated herewith in Fig. 1, where the axis of Y represents hours life, and the axis of X, watts per each candle of light produced. As this relation is confirmed by so many tests made at different times, upon lamps of different efficiencies, and under the care of different assistants, there can be no reasonable doubt as to its correctness. From a limited number of experiments made on many other lamps having treated carbons, it is indicated, as might be expected, that the relation between the lives and efficiencies of their burners follow the same general law. Therefore, if we assume that these lamps are constructed with the same detailed attention to design and manufacture, we may then also assume that their curves will not vary materially from that of the Sawyer-Man carbon.

The exact mathematical expression corresponding to this curve is somewhat complicated, but we can express the relation within one-half of one per cent. by the formula,

$$L = 3.742\ E^{-5.13} \qquad (1)$$

where L represents hours life, and E watts per candle.

During the past year a great many tests have been made by Mr. Smith with the super-treated carbons of the Westinghouse stopper lamps, and the relation between life and efficiency thereby found to exist is illustrated by another curve, shown at *B*, Fig 1. With the same degree of accuracy as above, we may represent this curve between commercial limits by the equation,

$$L = 5.44\ E^{-5.68} \qquad (2)$$

We note that this curve corresponds very closely in its general form to the curve of the treated burners, except that for a given efficiency the life of the super-treated burner is always longer. This is as it should be, inasmuch as the super-treated burner is, in fact, a treated burner which has been subjected to an additional process to render it more stable.

In 1885 John W. Howell presented a paper before this association, in which he exhibited a curve stated to have been constructed from the results of a large number of tests made with the Edison or untreated burners. I have taken the liberty of reproducing a part of this curve in this paper, shown at *C*, Fig. 1, but using a different scale of measurement. It will be noted that this curve is very similar to the curve of the treated and super-treated burners and, considered between the same commercial limits, we can express it with equal accuracy in the formula,

$$L = 1.052\ E^{-3.226} \qquad (3)$$

L and E having the same significance as before. For a given efficiency, we find the corresponding life of the curve of [illegible] by tracing a perpendicular line until it intersects the proper curve, the corresponding life being found directly opposite the point of intersection horizontally. Thus for an efficiency of 2.5 watts, we find the life of the untreated burner to be 400 hours, of the treated burner, 713 hours, and of the super-treated burner, 962 hours.

It is important to remember that these curves represent the results of laboratory tests, in which the electromotive force is kept more nearly constant than is ordinarily possible under the conditions of central station lighting. Therefore, in order to obtain an expression which will represent commercial conditions, we must introduce the element of a variable electromotive force. In Fig. 2 I illustrate a curve verified by numerous and exhaustive tests by Frank Stuart Smith, showing the relation between total energy consumed and the light emitted. This relation is such that a line drawn from any point of the curve to *O* (as *AO*) equals the tangent of the angle made by such line with the axis of X. It is represented by the equation,

$$I = \frac{W^2}{\sqrt{R^2 - W^2}} \qquad (4)$$

where I equals the total illuminating power expressed in candles and W equals watts, R being a constant, which depends for its value on the size and efficiency of the lamp. R is, in fact, the radius of the circle to which our tangent is referred. While the position of this curve varies with different lamps, the relation between the watts consumed and the light emitted remains unchanged through all tests. We know that the resistance of a heated filament will remain practically constant through the comparatively small variations in voltage to which a commercial lamp is subjected. Therefore if we let p equal the per cent. variation in electromotive force, we may write from our fundamental electrical equation $(1+p)C = (1+p)\frac{e}{r}$, whence

$$W_1 = W(1+p)^2.$$

By a combination of this equation with formula 4, we get the expression $\left(\text{since } \frac{W}{I} = E\right)$

$$E = \frac{\sqrt{E^2+1-(1+p)^4}}{(1+p)^2}$$

where p equals per cent. variation in electromotive force due to commercial conditions. Substituting this value of E, therefore, in equation 1, we get the expression for the commercial curve of the treated filament

$$L = 3.742 \frac{[E^2+1-(1+p)^4]^{2.565}}{(1+p)^{10.26}}.$$

By substituting the same value in equation 2, we get the expression for the commercial curve of the super-treated filament

$$L = 5.44 \frac{[E^2+1-(1+p)^4]^{2.84}}{(1+p)^{11.36}}.$$

Again, by substituting in equation 3 we get the expression for the commercial curve of the untreated filament

$$L_{111} = 1.052 \frac{[E_{111}^2+1-(1+p)^4]^{3.226}}{(1+p)^{12.904}}$$

It is, of course, impossible within the limits of this paper to attempt to express all conditions; but by a comparison of laboratory and central station records a fair average assumption seems to be that, with proper attention to regulation, the commercial variation is equivalent to a constant excess voltage of 3 per cent. I have taken this as a basis, and constructed commercial curves for the treated, the super-treated and untreated filaments, which are shown as dotted lines in Fig. 1, and designated as *A*, *B* and *C*, respectively. It now becomes possible to calculate accurately the efficiency at which any class of lamps should be burned in order that they may yield the best economy.

It is important to note the great effect that a comparatively small rise in electromotive force has on the life of a lamp. Any neglect to maintain the best possible regulation, therefore, will result in an increased bill for lamp renewals entirely out of proportion to the variation in voltage itself.

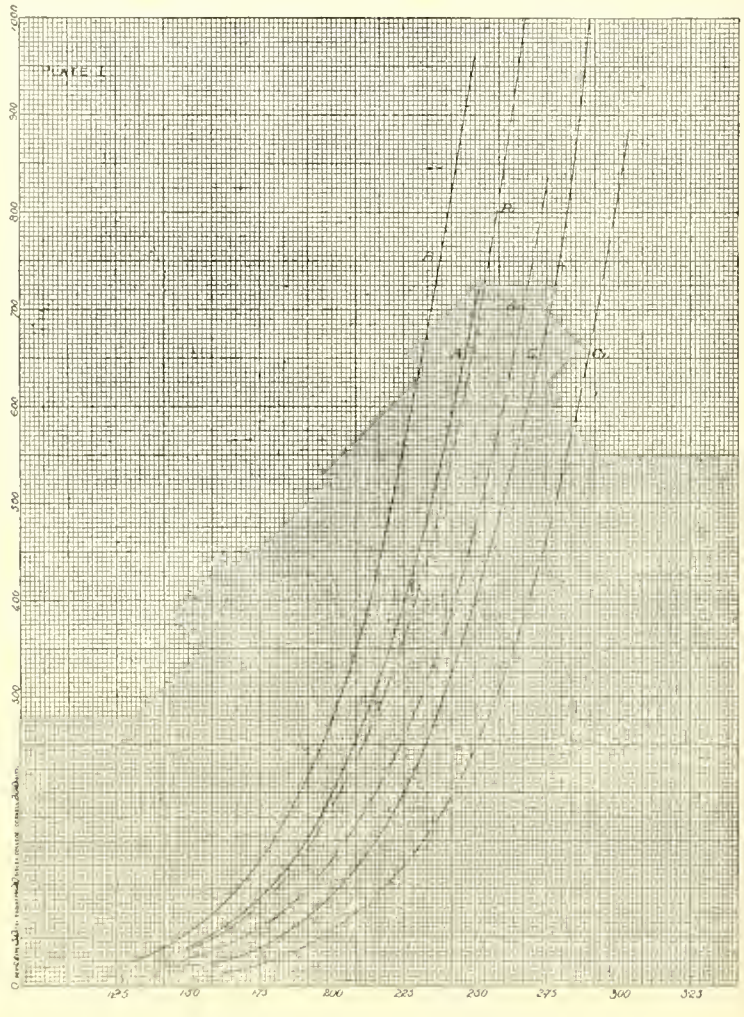


FIG 1. THE INCANDESCENT LAMP FROM A COMMERCIAL STANDPOINT.

The condition of the incandescent lighting business throughout the country is undeniably prosperous. Everywhere central station companies are wiring additional lights or preparing to increase the capacity of their machinery. We will not be far wrong, therefore, if we assume, in the consideration of our subject, that the central station company has a market for all the lamp hours it can furnish during a certain portion of the day's run. With this assumption let us formulate an expression for the profit in incandescent lighting, then we may determine what conditions will give this profit a maximum value. In the consideration of this matter I have taken as the unit of value one 16 candle lamp hour, assuming that what the public wants is light, and that, other things being equal, it does not care whether much or little energy be expended to produce it. Therefore, whenever we can increase the efficiency of our lamp, we not only reduce the cost of the energy required to burn it, but also increase the lamp capacity of our station, lines, converters, etc., by a proportional amount. Owing to the fact that the various meters in use measure, not light, but energy in one form or another, when we make our unit the lamp hour and afterwards increase the efficiency of our lamp, we must also increase our charge per unit of energy in order to maintain the same standard of price. Were any unit of energy to be taken as the unit of value, the receipts from a given output would become fixed, and the best lamp at once the most inefficient and longest lived. Political economy is clear, however, that to reduce the price of any commodity increases the demand for it, and in competition with other illuminants the only proper standard

can be that of illuminating power. It is nearly always possible to change existing rates whenever it is proper to do so.

With our unit of value illuminating power, therefore, our profit will obviously be the difference between the cost and selling price of a lamp hour multiplied by the

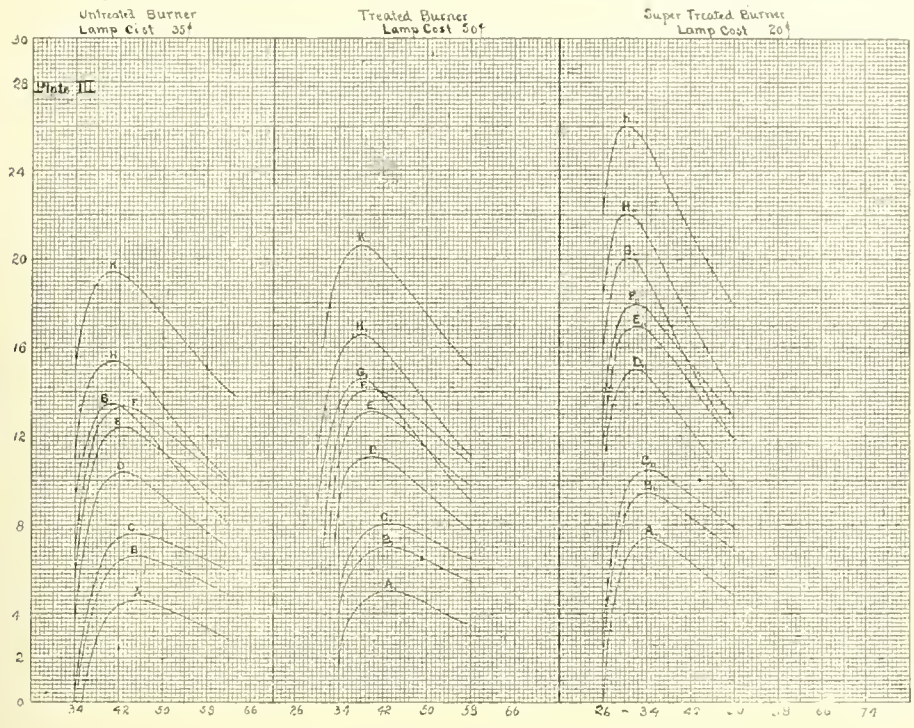


FIG. 3. THE INCANDESCENT LAMP FROM A COMMERCIAL STANDPOINT.

	A	B	C	D	E	F	G	H	K
V	.005			.0 75			.01		
g	5	3	2	5	3	2	8	6	2

number of lamp hours sold. We may, therefore, write the expression—

$$P=(v-c)\frac{S}{W}$$

where P equals profit, V selling price, c cost of lamp hour, S output of station in watt hour for the time for which our profit is estimated, and W watts required per lamp. Again, the cost of producing one lamp hour is clearly the proportionate cost of the lamp itself plus the cost of the energy consumed by it. We may, therefore, write—

$$c=\frac{1}{L}+\frac{g}{1000}W$$

where 1 equals cost of a lamp in cents, L it's life in hours, and g cost of producing one kilowatt hour of energy, substituting in this expression, from the formula of our commercial curves, the value of lamp life in terms of efficiency (bearing in mind that for a 16 candle power lamp $E=\frac{W}{16}$), and putting our expression for the value of c in place of c in the formula representing our profit, we have the equation—

$$P=\frac{VS}{W}-\frac{S1\,(1+p)^{2b}}{Wa\left[\frac{W^2+2\ 6-256\,(1+p)^4}{256}\right]^b}-\frac{Sg}{1000}$$

where a and b stand, respectively, for the coefficients and exponents of the second terms formulæ (1), (2) and (3).

Curves similarly lettered are constructed with similar values of g and v, the differences in their position and form being caused partially by the different costs of the lamps and partially by the differing relations between the lives and efficiencies of the several classes of carbons.

I illustrate in Fig. 3 a number of curves constructed for the untreated, the treated and the super-treated filaments, using this formula. I have taken the original cost of the lamps at, respectively, 35, 50 and 20 cents, the selling price of a lamp hour at, respectively, .5, .75 and 1 cent, and the cost of producing current at, respectively, 2, 3, 5 and 8 cents per kilowatt hour. By the courtesy of a considerable number of central station managers, who have furnished data concerning their respective plants, the average cost of this energy appears to vary between 3 and 7 cents. The only cases where 7 cents is exceeded are those in which fuel is a very expensive commodity and the station output is small. Where 3 cents is too high a very cheap fuel is used and a very large station operated. In assuming these values, I believe that we have covered as nearly as possible the conditions which actually exist, but it is quite easy to adapt our expression to any set of local conditions.

In Fig. 3 you will note that the Y axis represents cents and the X axis watts per lamp; the station output estimated upon being the unit of one kilowatt hour. The highest points of our several curves represent the conditions under which our profits are a maximum, and the vertical distances between these highest points and any other points on the same curves show the loss in profit due to the use of a lamp of other efficiency than the most economical. The vertical distances between the highest point of any curve of one class of lamp and the highest point of a corresponding curve of another class of lamp show the profit or loss resulting from the use of different classes of lamps at their respective best efficiencies. Other combinations will be readily noted by observation. For example, with the price of a lamp hour at one cent and the cost of generating current six cents per kilowatt hour, the best result we may expect from the treated filament lamp at 50 cents each is, with a 38 watt lamp, i. e., 2.37 watts per candle, when our profit should be (see curve H) 16.6 cents per kilowatt hour. With the super-treated lamp at 20 cents, other conditions remaining the same, the best results are obtained with a 70 watt lamp and our profit should be (see curve H) 22 cents per kilowatt hour.

Considering all these curves together, two facts are especially prominent, namely: first, that although we have assumed strictly commercial conditions, the profits obtained are in excess of those actually made in practice, and, second, that the most economical lamp efficiencies are considerably higher than those of the commercial lamps now in use. It is interesting and very remarkable to note that in every case the profits fall off very rapidly for lamps of either too low or too high efficiency, the variation being more marked where current is dear and running expenses high. By putting these facts together, it is apparently clear that the long lived inefficient lamp is a very expensive article, and that too much weight has been given to the cost of lamp renewals, which shows prominently on the expense side of our ledger, while we have not paid enough attention to the great waste of energy due to low lamp efficiency. By a reference to Fig. 1, we note that the most economical conditions call for, in the case of the untreated filaments, a life of between 250 and 525 hours; in the case of the treated filaments, a life of between 2?6 and 620 hours, and in the case of the super-treated filaments, a life of between 138 and 260 hours; the shorter life being in each case where both the cost and selling price of the lamp hour is high. I submit these figures for your consideration.

You will note from Fig. 3 that with a charge of three-quarters of a cent per lamp hour and five cents for the expense of generating one kilowatt hour, the use of a 50 watt lamp loses the operating company 1.05 cents for every kilowatt hour sold when using the 35 cent lamp with the untreated burner; 1.4 cents when using the 50 cent lamp with the treated burner and 5.2 cents when using the 20 cent lamp with the super-treated burner, as compared with the profits which might be made if these various lamps were used at their respective best efficiencies.

It is gratifying to find that the possibility of increased profits carries with it the implied possibility of reduced prices to the public and, therefore, a great demand for light, and greater success to the companies furnishing the same, in competition with other illuminants.

I have said nothing in this paper in regard to fall in candle power, for the reason that, in both the treated and super-treated filaments, this fall is roughly proportional to the time the lamp has been burning, as compared to its total life; that is to say, if a filament has a life of 1,000 hours at a given efficiency, and during that time its fall in candle power is A per cent, if this filament is burned at an efficiency which will make its life 500 hours, its fall in candle power will still be approximately A per cent., so that our commercial results are not appreciably affected. For the untreated filament the fall in candle power is proportionately larger than in the other two filaments. Therefore, if we are making a comparison of total illuminating power per energy consumed, we must put the untreated filament on a somewhat lower scale than shown in the comparisons I have drawn.

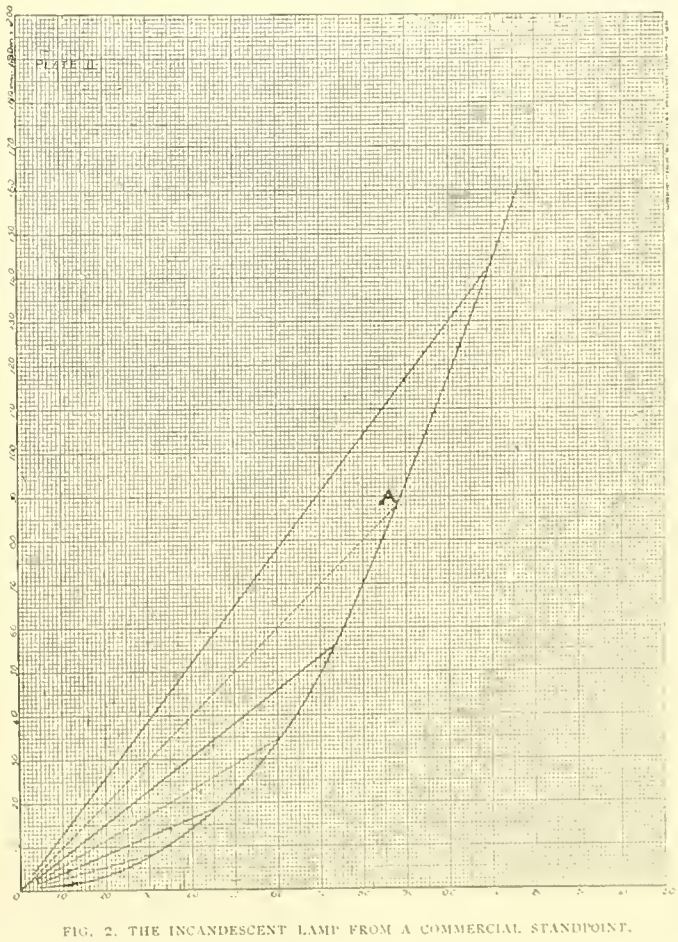


FIG. 2. THE INCANDESCENT LAMP FROM A COMMERCIAL STANDPOINT.

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THE wiremen employed on the World's Fair grounds who went on a strike will meet with no sympathy from the public. The men were getting the regular union rate—31½ cents an hour—and worked eight hours a day with a liberal advance for overtime. They demand 37½ cents an hour, for the simple reason, apparently, that any price they might set must be acceded to by the Exposition and Westinghouse companies owing to the pressing need for haste in the work. Fortunately this idea seems to be ill founded. The World's Fair people are hiring all the new men needed and there appears to be little prospect of serious interruption to the work.

THOSE who are interested in the incandescent lamp situation—and what member of the electrical fraternity is not?—will find much of value in Calvert Townley's convention paper on "The Incandescent Lamp from a Commercial Standpoint." The article is written from the point of view of a Westinghouse engineer and is more severely technical than its title would indicate, but the conclusions drawn by Mr. Townley from the formulæ and curves presented will be carefully examined nevertheless. His remarks concerning the best efficiencies of filaments are interesting, and the paper as a whole is one that deserves a careful reading.

THE convention of the National Electric Light association at St. Louis last week was in many respects the most satisfactory meeting in the history of the organization. The business of the association was conducted expeditiously and the discussion of the papers presented was interesting and at times animated. There was no general exhibition of apparatus, but several companies made special displays in the hotel parlors. The social features of the meeting were all that could be desired, and everything that could add to the comfort and entertainment of the visitors was provided. Altogether the meeting was highly successful and will be remembered by all who attended it.

THREE papers relating to the electric transmission of power were presented at the St. Louis meeting and they received close attention. Dr. Bell's paper was especially interesting. It is a valuable contribution to the literature of this subject. He said that the foreign experiments were not reliable and were of no practical value, as they had been clumsily conducted. Many of the recent "inventions" in this line which are now attracting attention abroad he pronounced as adaptations of the motors of Thomson and Tesla. The papers by Messrs. Bradley and Stillwell also attracted attention and deserve a careful perusal by all who are interested in the transmission of power by electricity.

IN the course of an interesting article on electrical nomenclature, brought out by the approaching World's Electrical Congress, the *Electrician* of London takes occasion to express its disapproval of the word "installation," which it styles an "affected and pompous term." "Plant," "job" and "work" are mentioned as preferable words for the expression of this idea. We fail to see the force of our contemporary's objection. Even if the proposed substitutes were exact synonyms, which they are not, the only possible criticism of "installation" would be the unimportant one that it is a polysyllabic word. Webster mentions "to give a place to" as one of the definitions of the verb "to install." That is precisely what is done when an electrical plant is put in or installed, and it is entirely correct to refer to it thereafter as an "installation." "Plant" is driven to death, "work" is awkward, and "job" is inexpressive, so that "installation" has an important and useful place.

THOSE who have attended the meetings of the National Electric Light association for the last four or five years, and those who have followed the proceedings closely, will appreciate the remonstrance made by T. Carpenter Smith at the St. Louis convention against the waste of valuable time in discussing subjects that have been worn threadbare, especially when the speakers have no original ideas to advance. Admitting the importance of the subjects and the necessity of keeping the matters constantly before the members, it is nevertheless annoying to have the greater part of the time devoted to such discussions, when it could be much more profitably devoted to other business. A perusal of the proceedings of the conventions held during the last three or four years shows that certain subjects have been discussed at every meeting by several gentlemen, and that with slight verbal variations the same views have been advanced. The association has other and more important business to transact than listening to a lot of glittering generalities which do not add to the fund of human knowledge. Here is an excellent opportunity for the new administration to effect a much needed reform. If President Armstrong will get the association out of the rut into which it is settling, he will have accomplished a lasting service to the organization.

"THERMAL Storage for Central Stations," the subject of Prof. Forbes' paper before the association at St. Louis, is a topic which has not received as much attenton in this country as in England. Dr. Forbes is an enthusiastic advocate of the plan of establishing a system of furnaces for the cremation of garbage and refuse in cities and utilizing the power for generating electricity. Dr. Forbes outlined his plan before the association and presented valuable data, the result of experiments conducted by him and extending over a term of seven or eight years. In this connection Prof. Forbes described the scheme of Druitt Halpin of England, which he believed could be advantageously combined with his own project. In the discussion which followed it was suggested that storage batteries be used for reserve power, but Prof. Forbes did not favor this scheme. He believed that storage batteries had an appropriate place but thought that they could be utilized in isolated work much more advantageously than in central stations. In England they were used much more extensively in this line than in this country. "There are," he said, "a number of storage batteries that are available, and yet no one seems to work at them here. I have been told that it has been a question of patents; but this is hardly a reason, for some of the best batteries are founded on the Plante system, and that is open to the whole world." Enumerating the advantages of storage batteries in isolated plants Dr. Forbes referred to the ability of ordinary workmen or servants caring for the plant. T. Carpenter Smith called his attention to the fact that while in England this might be true, it did not apply in this country where servants and employes were, he believed, less attentive and much more independent than abroad. Dr. Bell thought that the reason the storage battery had not proved successful in this country was that it had been exploited for work which it was least fitted to do economically, such for instance as street railway operation. Moreover, it was pointed out that batteries used abroad were much larger and stronger than those made in this country.

AMONG the papers presented at the St. Louis convention of the National Electric Light association was a contribution by W. H. Browne of New York, on "Underground Conduits and Conductors," in which an historical sketch of the controversies between the local companies and the city officials of New York was given. Readers of the WESTERN ELECTRICIAN are familiar with the facts in this celebrated discussion, yet the abstract of Mr. Browne's paper, which is presented elsewhere in this issue, may serve to refresh their memories. It was generally believed by the electrical fraternity at the time that the companies had been unfairly treated, that the display of official zeal was made for political effect, and that there was justification for the claims of the electric companies that unnecessarily harsh measures had been adopted. This view, it may be added, is still generally entertained, yet at the St. Louis meeting one of the delegates boldly asserted that the companies were not deserving of any sympathy. They had, he said, ample opportunity to protect their interests before the crusade against overhead wires was begun, but they not only refused to take advantage of the city's offer but did everything in their power to obstruct the progress of the contemplated improvement. They had exasperated the public, otherwise the people of New York would not allow the city officials to engage in the work of destruction, which proved so disastrous to electric lighting interests and caused so much inconvenience to the public. Much may be said in support of both of these views, but to the unbiased observer it appears that a conservative middle course would have been much more consistent with the best interests of all concerned. The experience of New York should not be without good effect. City officials should learn that they cannot attack the property of corporations without causing inconveniences and discomforts to the general public, and electric companies, on the other hand, should understand that in order to retain the good will of the public they should evince a disposition to accede to all reasonable demands.

The suggestion of Mr. DeCamp that the city build conduits was not received with favor. It was pointed out that with a system of conduits established it would be a very easy matter for the city to provide a generating plant and engage in electric lighting. This was a prospect that was not relished by the members of the association, and Mr. DeCamp's proposition received little encouragement.

Electricity at the World's Fair.

The strike of the wiremen has not caused serious trouble at the exposition. In explaining the matter Electrical Engineer R. H. Pierce said:

The men have been given what the union asks for—31½ cents per hour. We have been giving them time and one-half for overtime and double time Sundays, while the constitution of the union only calls for time and one-half for overtime on Sundays. The strike is confined to the World's Fair grounds. The men have been working eight hours per day and have been getting better pay than they would receive working down town. There were 225 men employed on the grounds by the Exposition company and by the contractors. The day of the strike about seventy of the World's Fair men went out and also fourteen men employed by the Westinghouse company. The statement is made that the Exposition company has been sending to different cities for non-union men. We have not advertised nor sent for more men. We simply take on competent men as they apply and are needed. All electrical work is getting along rapidly and has not been seriously interfered with by the strike. This is the time of year when there is no difficulty in securing all the wiremen needed.

Much more serious than the strike is the delay caused by the severe weather, and the electrical construction work has been greatly interfered with. A large number of the ducts are filled with ice, and the efforts of the electrical engineering department last week were largely devoted to thawing them out. All kinds of boilers were pressed into service, hastily mounted on trucks and used for blowing steam through the ducts. Fourteen thawing machines of this character were rigged up and made considerable impression on the ice. Everybody at Jackson Park, however, is praying for fair, warm weather.

Many of the attendants at the St. Louis convention went home by way of Chicago, and nearly all paid a visit to the World's Fair. Among the callers at the Westinghouse headquarters on Friday of last week were Prof. George Forbes of London, T. Carpenter Smith of Philadelphia, and L. B. Stillwell, Calvert Townley, Alex. J. Wurts, G. H. Blaxter, R. G. McGonnigle and Frank Moore of Pittsburg. All expressed the most enthusiastic appreciation of the exposition, particularly of the electrical features.

The Westinghouse company will erect two 25-ton hand cranes over five of the direct connected alternators in its exhibit in machinery hall. One crane will have a span of 30 feet and the other of 20 feet. These cranes will greatly facilitate the handling of the parts of the big dynamos and engines, as this part of the exhibit is not reached by the Sellers electric traveling crane, which is nearest to the Westinghouse space of the three traveling cranes.

About 10,000 of the new Westinghouse glass stopper incandescent lamps are now on the grounds, and the work of substituting them for the Edison and Sawyer-Man lamps used for temporary lighting was begun this week. The latest form of Westinghouse lamp has a coiled filament.

It is said that a line of electric buoys is to be placed by the government between the Van Buren street pier and the World's Fair pier at Jackson Park. There will be fourteen or more of these buoys placed half a mile apart to indicate night and day the safe course over which vessels between the two points are expected to run. South-bound boats must keep to the west of the line and north-bound to the east. A revenue cutter will patrol the course and vesselmasters violating this rule will be at once arrested and subjected to a fine of $100. The Government Lighthouse Board will install the buoys.

Judge Grosscup has refused to grant the injunction asked for by the Babcock & Wilcox company against the World's Columbian Exposition company and others, restraining the fair officials from allowing the Stirling company to place an exhibit of boilers alongside the Babcock & Wilcox company is exhibit in machinery hall. The reason given for the exclusion of the Stirling people was that the complainant was to have the remaining space if the fair needed additional boilers. In his decision Judge Grosscup held that there had been no agreement, and that the court could not interfere with the discretion of the director general. Again, the proposed privilege had not been submitted to and approved by the council of administration. After stating that the Babcock & Wilcox boiler plant was acknowledged to be an exhibit, Judge Grosscup said: "Nothing is clearer than that the installation of the exhibits is exclusively within the control of the commission. In this respect the local corporation and its agents have no authority."

A number of exhibitors in the department of electricity have found difficulty in properly classifying their apparatus, and to remedy this a special arrangement has been made with the director-general by which a new group has been added to the original classification. Classes have been added under this group sufficient to cover a variety of apparatus either properly electrical or auxiliary to other exhibits essentially electrical in character, and it is hoped that this new group has been made general enough to cover everything not heretofore classified. Those exhibitors who have found difficulty in properly classifying their exhibits will confer a favor on the department by sending immediately a list of those things in their exhibits which can be better classified under this new group than in the old classification. The group is known as 138 *A*, and contains ten classes, as follows: (*a*), Construction tools, repairing tools, apparatus used in electrical construction; (*b*), apparatus for transmission of power to electrical generators (steam, compressed air, turbine, oil, friction, gearing, belting, etc.); (*c*), processes of electro engraving; (*d*), carbon and its application; (*g*). metals and their application in the construction of electrical apparatus; (*h*), the "kinetograph"; (*j*), direct coupled engine and dynamos; (*k*), electric lubricators; (*l*), application of electricity in testing and aging liquors; (*m*), electric tanning.

Adolpho Aschoff, secretary of the Brazilian commission to the World's Columbian Exposition, reports that while Brazil does not propose to make an electrical display in competition with the United States, it will nevertheless make an interesting showing in its 1,000 feet in the electricity building, principally of telegraphic apparatus.

Preparations for the World's Electrical Congress are proceeding at a satisfactory rate. A large attendance of English electrical scientists is assured, and the continent will also be well represented. Prof. T. C. Mendenhall of Washington, superintendent of the United States Coast and Geodetic Survey, has accepted the chairmanship of the committee on programme and papers. Prof. Mendenhall's name will add much strength to the programme.

Long Distance Transmission of Power.[1]

By Charles S. Bradley.

It now lies within our means to build an electric transmission of power plant from coal mine to city, which shall cost $300,000, and will transmit 5,000 horse power; this plant will do the work of 30,000 men steadily day and night, year in and year out, and once placed will last a lifetime. The $300,000 represents the work of the 30,000 men for about four days, or an outlay of ten dollars each; thus these men can build a plant in four days that will do more work during their whole lives than they can. Can anything appeal to the imagination of man with more force? The energy of 5,000 horses transmitted noiselessly over a small wire, the coal from the mine placed by one act immediately beneath the boilers, the energy thence running to its destination without any labor from man, the air to supply combustion taken in the country, thus not robbing the human being gasping for breath in the city; the smoke and foul gases being thrown off where they will do no harm.

The only way now known to man of converting chemical energy directly to electricity is illustrated in the primary battery, where a conducting electrolyte forms a path for the current, and at the same time carries the elements that are to be consumed toward each other. This to all appearances is inherent. It necessitates that the oxygen shall have abandoned the gaseous state and enter the liquid. The coal demands for working a high temperature; therefore, the oxygen must have entered liquid condition and stays so at high temperatures. There are substances, such as permanganate of soda and the chromates, that seem to approach very close to filling these requirements as an electrolyte; that is, they will at high temperatures absorb oxygen from the air. They will also act chemically on the coal and produce a current. But now we are coming to the limitation again. The specific resistance of these substances is too high and the electromotive force too low, being between .9 and 1 volt, to give a reasonable amount of power from a given size of apparatus. The most promising of all fields to increase the efficiency of the convertion, I believe, lies in the gas engine, the atmospheric gas engine of Otto Langen having reached the high efficiency of 72 per cent. In this engine the piston is allowed to shoot up by the explosion and do its work in the descent. There seem to have been mechanical difficulties in the way of the success of this machine, but these can be overcome. Then, suppose we have an efficiency of .72 in an engine and 75 per cent. in transmission, we will have, all told, 54 per cent. of the energy of the coal delivered to point of consumption, which will make electrical heating not only possible but preferable to any or all other forms. Thus we may hope at no distant day to burn all coal necessary for the uses of a great city at the mine. Farther, we may take from the coal first its chemicals, which have become so valuable in the arts; then use the balance as gas in our engines.

For the electrical transmission of power we have two general systems—the alternating and direct. The multiphase alternating was advertised extensively by the Lauffen-Frankfort plant in 1891. This pioneer plant was built by much sacrifice of time and money, and we owe gratitude and honor to these men whose indefatigable efforts accomplished the beginning of an art which is destined to revolutionize the social status of mankind. This plant proved conclusively that very high voltages could be successfully used and the insulation maintained. This is the whole thing in a nut-shell; the choice of this or that particular way of generating and using the energy is of secondary importance, and with [illegible] situation. Surprising as it may seem, the insulation of the insulation was the least trouble in the operation of this plant. One of the greatest was the interference with the telegraph. The next difficulty in importance is thestatic induction; each wire, being so long and exposing so much surface, becomes a reservoir for [illegible] electricity, and the generator must fill this reservoir on each impulse before it can deliver energy at the distant end. When the generator reverses the direction of current system, as it does some 100 times per second in the alternating, this reservoir must be discharged and filled with electricity of opposite sign; that is, if the first impulse to a given wire was positive and fills its capacity with the positive electricity, the reverse impulse must discharge the positive and then fill the reservoir with negative electricity. This operation consumes but little power; it is an ebb and flow, as it were. The trouble, however, is that this idle current swinging back and forth occupies the carrying capacity of the generating apparatus; so much so, that I saw the fuses blown at Lauffen with no load of consequence at the Frankfort end. In damp weather the insulators become wet on the external surfaces, and this largely increases the capacity, which is more serious than the increased leakage. These difficulties vary with the length of the line and the amount of power transmitted, the surfaces being proportional to the length of line. The carrying capacity is proportional to the square of the diameter of the wire, while the static capacity is proportional to the surface, which is equivalent to being proportional to the diameter, so that the larger the amount of current transmitted the less proportional influence the static capacity has. These things must be determined by the engineer in each case. The Lauffen Frankfort was an extreme case. First, the line was much longer than we shall expect for some time to come in practical work; second, the plant was intended for 300 horse power and a rate of 40 phases per second. Owing to the static effects at 40, the rate had to be lowered to about 23 per second; this obliged them to run the dynamo at very much reduced speed, so that it was capable of only about 100 horse power, and this reduction increased the proportionate effect of the static charge.

In long distance transmission the lines should be carried on poles whenever it is possible, for the farther apart the conductors are, the less will be the inductive capacity; if placed under ground they will of necessity be near together. The placing in separate conduits to gain distance will not help, for the nearness of the earth is the equivalent of the nearness of the conductor of opposite sign. These things are only warnings, however, and slip out of sight with proper precaution. The multiphase alternating is the most pliable, adjustable system that has ever been conceived. It is capable of transformation in voltage; will supply motors of either synchronous or non-synchronous type; will readily convert in motor transformer to direct current for electric railroad or direct current distribution, and thus supply direct current motors. A patent was issued to me October 2, 1888, which covers this ground, and it is surprising and gratifying to read the original specification filed April 23, 1887, now nearly six years ago, and note there the complete provision for the transformation for these varied uses.

Where the power is to be delivered in compact form the direct current offers some important advantages. We can get very high voltages by a battery of machines placed in series for the generator and motor stations. The placing of machines in series for power transmission was proposed by Mr. Edison in 1880 and Prof. Thomson in 1883. Each contributed some essential improvement, but it is evident that the enormously high voltages now contemplated were not then thought of. For the generator station I prefer compound wound machines; first, that the system may be self-regulating; second, that the series coil when a machine is thrown into action shall magnetize the field in the right direction; this also requires that the switch shall close the series coil first. The shunt-coil would tend to reverse until the machine has attained electromotive force enough to overcome the resistance of its own armature. In order that each machine should be as far as possible independent of its neighbors, I prefer that it shall be short shunt, or in other words, the shunt coil be charged direct from the brushes of each machine. I would use the 500 volt machines, and of such ampere capacity as the size of the plant demanded, and belt them all from one shaft. The 500 volts have been found safe to life, and the commutator works well. Now, we must protect the insulation of the windings; the end machines where the terminal voltage, say, reaches 20,000 volts may, in case of grounds, be subjected to the piercing strain of the entire electrical pressure. It is impracticable to insulate the windings of each machine to stand any such potential; therefore, we connect the windings of the machine at some point with the frame so that it may never be subjected to a strain greater than its own voltage; next each machine foundation is thoroughly insulated from earth, and, in case this insulation fails for any reason, the fuses of the line will be blown, thus protecting the whole structure. It is easy, however, to make this foundation insulation so perfect that no derangement will take place. For this, I have struck upon a cheap plan, which was not apparent at first. Having now provided for the insulation, we must next consider the safe handling of the machines. A moment's consideration of the electrical potential of each successive machine in the series will make it evident that the whole of each machine will attain the potential of its individual position; or, beginning at one end, each successive machine will be 500 volts above the preceding one. Now, it is a well-known fact that a man may be charged to a high voltage without any inconvenience. An illustration of this is found in the stool with glass legs that we

1. Abstract of paper read at the convention of the National Electric Light association at St. Louis, March 1, 1893.

used to stand on in school and be charged up until our hair stood on end. The danger to life comes from the passage of a current through the body. Now, like standing on the stool with glass legs, a man may be placed upon any one of these machines, and if he cannot touch any conductor to earth he is perfectly safe. We can use a wooden platform around and attached to the base of the machine, so that the man must cross it before he lays his hand on the metal part. Here, again, I want to point out how essential it is that the windings be in metallic connection with the frame for the safety of the man. It secures that no part of a machine shall exceed its own voltage, and, in case of a leakage in the foundation insulation, immediate detection. If this metallic connection were not provided and a leakage occurred in the foundation, you will readily see that it might be undetected, and a man touching the brushes and the frame would take a current through him of uncertain high voltage. At the motor station we use simple 500 volt shunt machines with the same precautions as at the generator station. Our power having been transmitted can now be converted into whatever may be demanded. If it is an electric system of distribution, we shall have the advantage of its being impossible for the high tension current to get into the system of distribution. If it is a large plant, the motor station may be subdivided into two or three parts, preferably in multiple arc, with the same potential on each. On very long lines I think the transmission must be done by direct current.

Power Transmission for Central Stations.[1]

By Louis Bell.

So far as distribution is concerned, we may divide electrical power transmission into three classes: first, the transmission of single units; second, the transmission of power to a center of supply from which point it is to be distributed in various ways; third, supplying the power for lights and motors throughout the length of the transmission line. Each of these classes of work imposes conditions on the possible methods of transmission, and requires special consideration. In new plants, hampered in no wise by existing stations, any one of these three cases may exist, perhaps the last two more frequently than the first. Where a single motor is to be employed, the problem is exceedingly straightforward. Where a new center of distribution is to be organized, some complications are encountered, but not serious ones. Where power is to be scattered along the line, however, conditions arise which are not altogether easy of fulfillment and require a good deal of special care and skillful engineering. In a general investigation of the methods which may be employed, the case stands somewhat as follows, so far as the central station man is concerned:

First, if the distance over which he is to transmit power is moderate, he may use the ordinary direct current generator and motor, displace his engine with the motor and go ahead. But unfortunately, direct current machines of any considerable capacity are practically limited in voltage by the existence of the commutator, an article on which central station men in general waste no love. Dynamos and motors of large size cannot, individually, in the present state of the art, be satisfactorily built for more than about 1,200 volts. Machines for greater voltage have very generally broken down in the experimental stage. For very small power units, arc machines might be employed, but for the purpose of the central station man, it is better to move his arc machines directly to the distant point. For voltages much in excess of that mentioned, we are then driven to the use of either direct current machines in series or alternating machines.

Where generators and motors are to be used as a single unit, direct current machines in series may be and are employed quite successfully, but as the voltage desirable on the line rises, the system contains a greater number of units and becomes more complicated and difficult to apply to central station practice. For instance, it is highly desirable for the successful operation of motors in series that they should be, practically, coupled to the same shaft, and should run under similar and uniform conditions, so while there are cases in which the method of coupling in series may be both convenient and cheap, it is in my opinion better general practice to employ alternating currents, after passing the ordinary limitations of direct currents.

Here we encounter a complicated state of affairs, for the central station man who attempts to investigate the subject is immediately surrounded by a cloud of mental dust, through which he sees dimly the outlines of plain alternators, biphase, triphase, and multiphase generators and motors, condensers, Geissler tubes, six-foot fuses, electrified wall paper and the other properties of a well-equipped modern high voltage electrician. The substance of the matter, however, is something as follows:

We want to use power transmission by alternating currents for two good and separate reasons: first, because we get rid of the commutator and can therefore use as high voltage as we can safely insulate in the machine; second, because by the use of transformers, we can obtain for the transmission line itself any voltage which we can insulate, and thereby enormously decrease the cost of the copper which must be bestowed away as permanent investment in our line.

Multiphase currents, and by this I mean currents having more than one phase, are subject to the same [illegible] as are other alternating currents. Their [illegible] in the fact that for alternating [illegible] of [illegible] are excellent motors [illegible] at a steady speed, start under [illegible] in general to [illegible] very much the same qualities as a well organized shunt motor of the ordinary kind. Incidentally, certain of the multiphase systems, more especially the three-phase, enjoy the advantage of effecting something of a saving in copper, under favorable circumstances up to 25 per cent. from what would be required by a plain alternating current of the same nominal voltage. This saving is merely from the fact that in the three-phase line, the currents do not have their highest value at the same time, so that at any particular instant two of the wires may serve as a sort of multiple return for the third. This advantage would be immediately thrown away, if for the three currents of different phase three separate pairs of wire were employed, as it is thrown away where for two currents of different phase two independent circuits are used.

The fundamental difference between single and multiphase systems, then, is mainly the adaptability of the latter for driving motors, and multiphase are better than single phase motors principally in their ability to start under load, and somewhat larger output for the same weight.

Wherever, then, single motors are to be driven for operating, we will say, an electric light station, it is largely a matter of convenience whether we employ single or multiphase motors. If the former can be conveniently started, they are fully competent to take care of the work, except in one special case which I will mention presently. The multiphase motors, whether synchronous or otherwise, start very freely, and may or may not be economical in cost of copper, according to the arrangements of the circuits.

A single case in which multiphase transmission becomes of great importance when the object is to work an existing central station is in that case where railway circuits are to be supplied. A railway machine is subject to so great and violent variations of load, that if it were driven by an ordinary synchronous alternating motor, the latter would run great risk of being pulled out of phase by a sudden short circuit, when it would stop and stay stopped until deliberately started up again. The multiphase motor can also be pulled out of phase, but not quite so easily, and it can be more readily started. We can, however, where railway currents are necessary, do much better than to drive the dynamos directly by motors of any kind. We can for this use start with the multiphase current, and through the medium of a single machine, scarcely more complicated than an ordinary railway dynamo, transmute this multiphase current into a direct 500 volt current of the ordinary sort. This very valuable result has been brought about through the ingenuity of C. S. Bradley, who invented the device half a dozen years ago. It has remained dormant, principally because there has been no special call for power transmission of any kind until recently, but to its thorough practicability I can personally testify, as a 100 kilowatt tri-phase direct current transformer which I recently tested, operated in the manner described, showed an efficiency of over 95 per cent. at full load, stood sudden variations from no output up to 100 kilowatts and back again without even a wink at the brushes, and bore up under heavy overload without difficulty. Whenever it is desirable to operate railway circuits by power derived from a distant source, these machines fulfill all practical requirements, and I believe are destined to come into very extensive use, and play an important part in the development of very long electric railroads.

To sum up this point, where single motors are to be employed for driving other electrical machinery, either synchronous, alternating or multiphase motors can be successfully employed. Where railway dynamos form a part of the load, a particularly good result can be obtained by using for this particular portion of the work the multiphase direct current transformers.

So much for the operation of existing plants by electrical transmission of power, where it is merely intended to substitute a motor or motors for an engine.

Now, take up the case where a center of distribution is to be fed, consisting it may be in part of an existing station and in part either of extensions and new circuits from this plant or subsidiary centers of distribution having other districts of the same town. Here the problem becomes more complicated and it is almost impossible to lay down any general procedure. Each case is best handled by itself. We can, however, enunciate certain principles which will aid in the discussion of any definite case.

First, we can feed all existing railway circuits and extensions very effectively and economically by use of the tri-phase direct current transformer just described.

Second, we can handle all direct current incandescent systems, whether two or three wire, by means of the same type of apparatus, the tri-phase direct current transformer.

Third, we can successfully operate any existing alternating incandescent circuits or any extensions thereof by feeding alternating current from the distant point directly into them through banks of transformers.

Fourth, if any new centers of distribution are to be made with circuits independent of those already in existence, we can operate these circuits very effectively for both lighting and motor service, if both be necessary, by employing multiphase apparatus; and right here let me say that there is one widely spread error which I desire most emphatically to contradict.

It has been asserted that incandescent lighting cannot be successfully done on multiphase systems, especially tri-phase, since this system happens to have been most talked about. This statement is absolutely false, to my own personal experimental knowledge. Lamps can be as successfully operated on systems of two, three or more phases as on an ordinary single phase circuit, provided equal pains be taken with the distribution of copper in the lines and the regulation of the voltage at the dynamos. If these conditions are observed, a two-phase circuit with separate wires acts substantially as if it were fed from two ordinary alternating dynamos. A tri-phase circuit gives a similar result, and if more phases were concerned, the same would be true. If the condition of constant voltage at the center of distribution be fulfilled, as it can be and must be for successful operation on any system whatever, two and three, phase incandescent lighting systems can and do work admirably. Furthermore, if we combine circuits, for example, if we use but three wires instead of six for the three-phase system, there is no exact equality of balance required between the lamps placed in different connections across these circuits. On the three-phase system we would place between each possible pair of the three wires this arrangement, gaining in copper wire enough to compensate for the slight inconvenience in connecting three sets of lamps instead of one or two. Branches can be run from any two wires of the tri-phase arrangement, and lights placed on them will act exactly as if they were placed on any ordinary alternating circuit. With such an arrangement you should be able to throw off all the lights on one side of the circuit, without producing any noticeable variation in the lights of the other two branches; no more variation, for example, than you would get, if on a given set of secondary mains from a common transformer, you were to turn off or turn on one-third of the total number of lights. If any man comes to me and says that a three-phase system will not run lamps successfully unless there is careful balance between the lights on different sides of the circuit, I have in that statement sufficient evidence to convict him either of ignorance of the principles of wiring and dynamo regulation or of willful misrepresentation of the facts. I lay stress upon this matter of incandescent lighting in defence of multiphase systems, because it is the one upon which they have been most often misrepresented, chiefly through foreign experiments, which I do not hesitate to denounce as clumsily conducted.

In taking up the condition I have just mentioned—that of new centers of distribution—may briefly refer to the properties of multiphase motors, which have been the subject of all sorts of curious misstatements. A multiphase motor, I do not care whether it has two or more phases, should if properly built have very nearly the properties of a good shunt motor, and not far from the same efficiency. Incidentally, it has the advantage of having no commutator and no necessity for any moving contacts. It starts under two, three or more times the running torque, just as a shunt motor does, and by virtue, if the torque is extreme, of a heavy starting current just as a shunt motor would. It comes rapidly up to a nearly fixed speed, and remains nearly at that speed under variations of load. If overloaded it stops, like any other motor. In addition, it has one great merit that shunt motors do not have, that of running at nearly constant speed independent both of load and moderate variations in voltage. It is on the whole less thin-skinned than a shunt motor. I have experimented with a considerable number of multiphase motors of the induction type, to which I here especially refer, and although I have seen some terribly severe tests in the way of overload, I never yet saw any symptoms of a burn-out. The efficiency of these machines should be and is at least within one or two per cent. of ordinary shunt motors.

There has been much discussion as to the relative merits of two and three-phase induction motors. In general the more phases, the smoother action of the machines in various respects. I have never yet seen a two-phase motor any better than a three-phase motor. I should want a pretty careful series of tests to convince me that I had seen one as good. The difference between them, with proper design, ought not to be very great, though the three-phase has the advantage in cost of wire. There are two important points in which multiphase motors have been misrepresented, which I shall mention:

First, it has been said of them that they take an enormous current when running light, and second, that they introduce a very large and most objectionable lag in the circuit, so that the apparent current on the line is much greater than the energy current. Such facts have doubtless been observed. Broadly speaking, they have been due to faulty design. A multiphase motor will always take a somewhat larger current when running idle than the corresponding direct current motor, but it takes very little more energy, as the phenomenon of lag then becomes noticeable, so that of the apparent current running light only a portion represents energy. It is a perfectly simple matter to cut down the current required by a multiphase motor running idle to twenty or twenty-five per cent. of the full load current, still retaining a motor excellent in its other properties. As motors where power is sold by meter are usually cut-off when not needed, the whole question of this idle current sinks into insignificance. The same is true of the alleged lagging current. If a multiphase motor (I speak with certainty at least regarding the three-phase) of 10 or 15 horse power should show at full load more than 10 or 12 per cent. of lagging current, I should consider it to be badly designed, so that these two questions of so-called idle current and lagging current as disturbing factors in a multiphase line can be and are reduced by proper care in designing to comparatively insignificant quantities. It has been very ingeniously suggested to give them a further shove down into oblivion by means of condensers, but it is a commercial rather than an electrical question as to whether leakage current and lag had better be thrown quite into the abyss by the added complexity of condensers or left hanging on the ragged edge without them.

In case, then, of working a central station from a distant water power where necessity for extensions or new centers of distribution exists, we have plenty of methods available: Tri-phase direct current transformers for railway and direct current lighting service, alternators to

[1] [illegible]

feed into the existing mains or to supply extensions for them and for new centers where light alone is to be employed, ordinary alternating currents, or where both light and power are necessary, multiphase apparatus which, as I have shown, is entirely applicable for such a mixed system.

I may add that there is a possibility that we may have before long practicable motors to run on an ordinary alternating circuit constructed after such methods as were suggested by Prof. Thomson a few years ago. In very small sizes they are already practicable. Brown, abroad, has been making a desperate effort to exploit these very methods on his own responsibility and has obtained motors which run successfully but as yet do not start well under load. From what I can learn of them, I doubt very much if they are any improvement on the motors of the same type shown by Prof. Thomson at the Paris Exhibition or on Mr. Tesla's motors for running on a two-wire circuit.

Whatever the methods which may be employed, several serious questions must be confronted when one attempts to transmit power for supplying central station or any other apparatus. One of these which presents itself immediately is whether or not in an alternating transmission it is advisable to use step-up and step-down transformers. The principal determining factor in this is cost. The higher voltage we can supply direct from the machine without increasing its cost considerably, the cheaper we can make the installation. Unfortunately in building dynamos, the armature coils have to be insulated, and where the voltage is very high, the insulation is correspondingly thick, so that with a given amount of material, we must in building a high voltage machine take up with insulation the space which would otherwise be available for copper. The result is that a dynamo wound for 4,000 or 5,000 volts is intrinsically more expensive, unless the size be very large, than a machine wound for 1,000 or 2,000 volts, besides being considerably less reliable. Machines of such voltages as these have been built in this country and abroad and some of them have given very fair results, but they are expensive to manufacture, at whatever prices they may have been sold in individual instances, and it is my personal opinion that where it is necessary on the score of economy to raise the voltage as high as 4,000 or 5,000 volts, it is better and cheaper, unless the units be very large, to use step-up transformers and carry the voltage up to 10,000. Assuming 2,000 or 3,000 volts as the available potential obtained from the machine direct and then estimating the cost of a given installation, first using these machines and second using low voltage machines with step-up transformers, we find that at prices ordinarily charged for apparatus and copper, the two methods become of equal cost at a distance of somewhere about seven or eight miles. Above these distances, the step-up transformers cheapen the plant; below it, they increase the expense. We can draw the line at no specified given distance for the general case, but can very easily for any specific case.

The amount of drop advisable in these long distance lines will depend of course principally upon the relative prices for copper and the apparatus necessary. If copper be relatively cheap, it pays to employ a good deal of it. If apparatus is relatively cheap, it is better to use larger generators and allow more drop on the line; 15 to 20 per cent. will hit the large majority of cases on the score of economy and convenience. It should be remembered, however, that for such drops as these good regulation is most essential, but good enough is available with direct, alternating or multiphase machines, to make these drops thoroughly practicable. The approximate figures I have just given on the limitations of the step-up transformer and on drop are the result of the investigation of a large number of concrete cases which I have had occasion recently to examine in detail, and for a number of which the apparatus is now in process of manufacture. I therefore feel personally convinced of their practicability, both theoretically and otherwise.

But for the central station man who desires to decrease his operating expenses by the employment of electrical transmission the court of last resort is the balance sheet and the fundamental question is, "Agreed that it is practicable, will it pay?" I can give no general answer to this question, for each problem necessarily must be considered by itself. It is possible to formulate equations which will connect all the variable factors of cost and annual charges, so as to enable one to derive from them an answer to this all important question. But the character of such formulæ is necessarily so complex and involves so many quantities that it is generally easier to take a short cut to the result by making a few approximate estimates. I have, however, looked into the profit and loss probabilities of a large number of plants of all descriptions and in a general way one can say that power transmission to a central station will, unless the cost of developing the water power be very great, almost universally pay at distances of 10 or 12 miles or less. It will frequently pay up to 20 or 25 miles; now and then, under extraordinary conditions (very expensive coal and very cheap water power) up, to 40 or possibly even 50 miles. In using alternating currents at these long distances one naturally fears the effects of inductance in the lines and of static capacity. In very long lines, operated at high frequency, these difficulties may rise to formidable magnitudes. Knowing the dimensions of the line, the frequency and the currents, it is, however, possible to calculate the effects of these distributing elements with great accuracy. From these calculations I feel safe in saying that within the distances mentioned inductance and static capacity constitute no serious obstacles to success, if the frequency employed be moderate; such, in other words, as one would be led to select in considering the operation of motors alone. Large generators are as readily and nearly as cheaply built for frequency of 50 or 60 as for higher ones; sometimes more easily under these circumstances. I think cases would be rare where transmissions, the advisability of which would be dictated by commercial consideration, would encounter serious difficulty from inductance and capacity. I have never personally investigated a proposed transmission of over 50 miles that gave any promise whatever of financial success, but the time may come when such a case will appear, and if it does, the work can be done successfully so far as the electrical part of the matter is concerned. I think the greatest difficulty in surmounting long distances is the difficulty of keeping a long line in proper repair.

Throughout this discussion I have taken the position that no one method of procedure is applicable to all cases. Personally I am decidedly eclectic in my taste, believing that it is better to put in for each individual case such apparatus as on the whole proves to be cheapest and best rather than to advocate, on any fine drawn theories, methods which might be applied to the perfectly general case of transmission of power. It is the concrete rather than the abstract that we have to consider when proposing apparatus on which the success of large commercial affairs depends, and although some methods are better than others, it is well to remember that while the electrical pharmacopœa may have its calomel and paregoric it contains no elixir of life.

Remarks Concerning Power Transmission from the Economic Standpoint.[1]

By L. B. Stillwell.

At the Buffalo convention of the National Electric Light association, in February, 1892, in the general discussion of the subject of the electric transmission of power, a great deal was said about different systems of electric apparatus which might be employed for this purpose and various opinions were expressed concerning volts, amperes, cycles, alternating versus direct current systems, and one-phase, two-phase or three-phase machinery. The subject appeared to be one of great interest to the convention, and the discussion was more or less instructive. But the writer carried away from that convention the impression that, after all, the manager or owner of a central station, or the business man desirous of securing information as to the practicability of profitable investment, must have failed to derive any great amount of information of the kind which he desired to obtain. The first question of such a man is, "Does it pay?" and it is a question which an engineer who has become so involved in the consideration of technical points as to lose sight of the question of practicability from a business standpoint has great difficulty in answering. But the business man is right. "Does it pay?" strikes direct at the root of the whole matter. The practicability of all systems and of all projects of this description must be measured in monetary units, and electric transmission of power, as well as every other form of engineering undertaking, must find its ultimate reason for existence in considerations of economy. Any engineering project which cannot live when measured by this standard should never be undertaken.

In discussing the subject briefly from an economic as distinguished from a technical standpoint, I wish to say at the outsert that I am aiming to obtain information rather than to impart it. The question which the practical man asks as to the economy of a project is the most difficult to answer. Very few men, even among those who are actually operating central stations, are able to say exactly what power costs them, and it is not surprising that the engineer who is called upon to lay out, let us say, an elaborate plan for the utilization of water power finds it difficult to to give explicit answers to questions relating to the cost of operating such a plant, probable revenue to be derived from the sale of power, and, in general, economic feasibility. The best way to arrive at results of some tangible value is obviously to compare an hydraulic and electric transmission plant with a central station using steam engines to drive dynamos.

In the latter we have the steam plant, consisting of boilers, engines, pumps, heaters, etc.; the electric generating plant comprising dynamos, exciters, and all electrical apparatus located in the central station, and the distributing plant comprising motors, lamps, transformers, and the conductors connecting these with the central station. In the former case it is usually convenient to locate a sub-station at a point adjacent to the market, for example, on the spot where the central station would be located were we to obtain power from coal. In such a plant we have the hydraulic apparatus, comprising dam, flumes, draft tubes, turbines, regulators, etc.; the electric generating plant, consisting of generators, exciters, and all electrical apparatus located in the generating station; the transmission circuits between generating station and sub-station; electrical apparatus in the sub-station, which usually consists of transformers employed to reduce potential, together with switching and regulating apparatus; the motors, lamps and other translating devices, and the local distributing circuits connecting these with the sub-station. We may assume that the two installations from the point where the local distributing circuits leave the generating station on the one hand, and the sub-station on the other, to the premises of the consumer, are precisely similar. It is obvious that it is unnecessary to compare annual charges upon that part of each of the contrasted plants which lies between the customer and the central station in the case of the steam plant, and between the customer and the sub-station in the case of the hydraulic and electric transmission plant. In other words, that phase of the general problem which I have elected perhaps the most interesting may be stated:

What are the total annual charges against an hydraulic and electric installation utilizing cheap power at "A" and transmitting it to "B" as compared with the annual charges against a steam and electric plant located at "B," and capable of supplying the same amount of energy in equivalent form to the local distributing circuits?

We may conveniently construct algebraic skeletons or framework of the annual charges against each of these typical installations. When we come to translate algebra into arithmetic by substituting numerical figures for the algebraic symbols, opinions will differ widely as to the actual values of the different factors, but I think that the skeleton will be useful, as by discussing, and, if possible, fixing one factor at a time, we shall be better able to arrive at some approximation to a definite and tangible result.

In calculating the annual charges against the steam and electric plant we must consider the following:

Fb = First cost of real estate and buildings.
Pb = Percentage covering interest upon and maintenance of real estate and buildings.
Cb = Constant expenses, taxes, insurance etc., on real estate and buildings.
Fs = First cost of complete steam plant, including engines, boilers, steam pipes, pumps, heaters, etc., installed.
Ps = Percentage covering interest upon and maintenance of steam plant.
A = Cost of fuel to produce one pound of steam.
S = Pounds of steam used per indicated horse power per hour.
N = Number of indicated horse power hours used per year.
Ws = Cost of water (if any) per annum.
Os = Cost of oil and waste per annum for steam plant.
Fe = Cost of electric generating plant, including exciters, regulators and complete station equipment.
Pe = Percentage covering interest upon and maintenance of electric generating plant.
Oe = Cost of oil and waste per annum for electric plant.
Cse = Constant expenses including superintendence, wages, taxes, insurance, etc., steam and electric plant.

Then, PbFb + PsFs + ASN + Ws + PeFe + Os + Cse + Oe = annual charges.

For the hydraulic and electric plant we have the following:

Fb = First cost of real estate and buildings.
Pb = Percentage covering interest upon and maintenance of real estate and buildings.
Cb = Constant expenses, taxes, insurance, etc., on real estate and buildings.
Fh = First cost of hydraulic plant, including turbines, dams, flumes, etc.
Ph = Percentage covering interest upon and maintenance of hydraulic plant.
Oh = Cost of oil and waste per annum for hydraulic plant.
Ch = Constant expenses, including superintendence, wages, taxes, and insurance on hydraulic plant.
A = Cost of water per horse power hour (where water rate is paid).
N = Number of horse power hours at turbine used per year.
Fe = First cost of electric apparatus between turbine and local distributing circuits exclusive of line.
Pe = Percentage covering interest upon and maintenance of electric plant exclusive of line.
Oe = Cost of oil and waste per electric horse power from generators for electric plant.
Ce = Constant expenses, including superintendence, wages, taxes, insurance, etc., on electric plant.
Fl = First cost of pole line, insulators and conductors.
Pl = Percentage covering interest upon and maintenance of pole line, insulators and conductors.
Cl = Constant line expenses (supervision and repairs).

Then, PbFb + Cb + PhFh + Oh + Ch + AN + PeFe + Oe + Ce + PlFl + Cl = annual charges.

And now, what have we accomplished? We certainly have not arrived at a definite solution of the problem of comparative annual charges, and the more carefully one looks at the statements, the more evident does it become that there are many factors the value of which can only be fixed by actual experience. It appears, however, that were we in possession of accurate and detailed data as to the cost, operating expenses and income of a steam and electric plant, we might form a pretty accurate idea of the practicability of an alternative project involving electric transmission of power. We should also need some information as to the cost of installing and operating hydraulic plants under various conditions, but this can be obtained with sufficient accuracy and with no great difficulty.

This paper is offered simply in the way of suggestion and for the purpose of inviting criticism and comparison of opinions. The skeleton statements of annual charges have been hastily prepared and may doubtless be revised and amended with good results. It is intended simply for classifying purposes, to facilitate the accumulation of much needed data and to avoid confusion of ideas in discussion of the problem which I have attempted to analyze.

Discussion on Power Transmission.

President Ayer: The rapid development of our business brings forcibly to our minds the necessity of transmitting large amounts of power over long distances in large units, or on the other hand of maintaining central stations and smaller units. To-day we are placed in a peculiar position. Our attention is called to the direct system, moderate sized units, covering a large area, which looks to be a very practicable method for many uses, and also to one very large unit, transmitting power to centers of distribution and there distributing it, and a further suggestion comes to us, especially where we are located near coal fields of generating power at the mine and transmitting it to the points of distribution, so that it may be wise to consider the advisibility of one or the other of the multiphase systems that are offered.

Mr. Hammer: Dr. Bell asserts that it is not practicable to use multiphase machines of over 1,200 volts. I think there are machines, not very far from this city, running direct currents of 3,000 and more volts. Moreover, the other night, Prof. Crocker made the statement that he had been running for some time direct current machines of 5,000 or 6,000 volts without any difficulty whatever. I do not think that Dr. Bell placed enough importance upon the application of the transformer in this country. I think it would be very interesting to all the

1. Abstract of paper read before the National Electric Light association, St. Louis, March 1, 1893.

station men here if Mr. Bradley, Dr. Bell, Mr. Stillwell and others would say just why it is that the alternating motors of large capacity are not in use.

DR. BELL: In the first place we know we can make an arc machine to work on high voltage. I practically stated in the paper that high voltage could be used requiring the employment of 1,200 volts or thereabouts if the machine is designed to carry large currents. Experience up to date has shown that they will not work satisfactorily for any length of time. Although very estimable gentlemen may think that they can build 5,000 to 6,000 volt machines for large currents they had better build them for large currents before they brag much about them, for all machines that have been built for large currents and high voltage have come to grief. Try to run on 50 or 100 amperes and there is trouble at once. I do not feel at all certain that we may not be able some day, perhaps, in another world, to run direct currents at 3,000 or 5,000 volts, but all our experience has gone to show that when we have gotten a little above 1,000 volts we are in trouble so far as large powers are concerned, and I am not dealing here with matters of 50 or 60 or 70 horse power which can be transmitted by a pair of arc machines. As to the point of the tri-phase current I simply intended to convey the idea that there was a slight saving of copper. Of the direct current transformer I may say that I am very far from desiring to belittle it. The transformer which takes a current at 1,000 or 2 000 volts and brings it down to 100 or 200 volts may have a very direct application after we get the high voltage machine. Transforming from 1,000 down to 100 or 110 volts is pretty small business compared with transforming from 10,000 to 100 volts. The tri-phase multiple transformer is very much more simple than the machine which takes a high voltage direct current and transforms it to a low voltage direct current. The winding is more simple and the machine itself is more efficient.

As to why alternating current motors in large sizes have not been used up to the present time, I think the principal reason is that there has been no very large call for long transmissions until quite recently. It is perfectly practicable to run large synchronous motors—a matter about which there is no difficulty, and when occasion has arisen it has been done. So my answer to that will be that as far as the demand has arisen for long transmission employing alternating currents, they have been put in, and as that demand occurs they will continue to be put in.

MR. HAMMER: In St. Louis there is a large alternating current station, and I cannot believe that an establishment of that kind would not be very glad to have a large number of 15 or 20 horse power motors to run elevators and do other work of that kind.

MR. BRADLEY: I tried to build those motors, and I have not been able to do it. We succeeded in building a motor to work on a single-phase alternating circuit which had an efficiency of 52 per cent, 1 to 2 horse power We have never been able to construct one without a commutator, and wherever a commutator is used the sparking is something dreadful. If it is not bad when the motor is first started; after a few hours it becomes very bad, and we have not been able to design any brush that will obviate the difficulty.

DR. BELL: If Mr. Hammer meant to confine his question specifically, as I understand now he did, to the alternating current, single-phase motor, the reason why more of them have not been put out is that such motors as a rule do not start very well in small sizes. The broad distinction between single-phase and multiphase motors is that the single-phase will not start with sufficient facility to give them a good grip.

PROF. WESTON: I think that Mr. Bradley hit the nail on the head a moment ago when he frankly admitted that he had tried to build an alternating motor of large power but had been unable to do so. There can be no question as to the fact that there has been, and still is a large demand for such a system of transmission of power as has been referred to, viz , a simple transmission by means of the ordinary alternating current generator. I would like to ask Dr. Bell why he makes the statement that 1,000 volts is the limit of work for the direct current, giving anything up to 100 amperes. I do not think that statement was well founded. I do not know whether Dr. Bell has any particular instance in mind, if so, I do not think the machine could have been designed correctly. I am quite sure of that, for with correctly designed machines I do not think there is any difficulty in running up to 5 000 volts, and with very large currents, even to several hundred amperes. The question of the advantages of the two processes is still an unsettled one, and will not be settled probably for some years to come; it is a question of the survival of the fittest.

PROF. FORBES: Both the three-phase and the two-phase systems are working very satisfactorily in Europe. I have examined the apparatus and have made tests of the efficiency and I feel confident that we shall get very good results from those two systems. Of course there are two problems totally distinct, as has been already mentioned, the question of transmission of power, and the question of distribution of power. Of course, besides these two systems of transmission and distribution, for these are systems which are very applicable for distribution as well as transmission, we have also the single-phase system, which works remarkably well, and of which we have had considerable experience in this country as well as in Europe The only town in the world that I know at the present moment where alternating currents are used for distributing power is at Heilbronn, Germany, but there may be others with which I am not acquainted, that, too, is on a very small scale; indeed, the amount of horse power distributed there is very small. This only shows that the objections which were originally raised against the alternating current for use as motive power have not been completely annihilated up to the present time, but that need not prevent those engineers who have the most confidence of their views from proceeding to do large work with the alternating currents. In this respect I may, perhaps, be permitted to say a few words about the use of alternating currents with a single-phase. I have seen at least a dozen classes of alternating current motors of a single phase all working fairly well, but there are none of them being put at the present time largely on the market. I am speaking now of motors which will start from rest with a good powerful twist, and which will keep up their speed and work economically.

Wrought versus Cast Iron for Field Magnet Frames.[1]

BY A. D. ADAMS.

The modern bi-polar dynamo may be broadly divided into two essential parts, the field magnet and the armature. The office of this armature is to conduct magnetism through its core, and cut or cross this magnetism by means of its windings or inductors. The office of the field magnet is to conduct magnetism from one side of the armature to the other, and usually to carry the field coils.

It is entirely possible to draw a current from an armature, when revolved within an exciting coil, even though it have no field magnet to complete the magnetic circuit.

One objection to such an arrangement would be the excessive amounts of copper and energy required in the exciting coil for a given effect, as the lines of magnetism would have to pass through the air in order to complete the magnetic circuit from one side of the armature to the other. The great advantage of the combination of the armature and field magnet lies in the fact that the field magnet forms a magnetic path of much less resistance than the air. The same reasoning that leads to the completion of the magnetic circuit through the field magnet seems to indicate that the best metal for this purpose is that having the greatest magnetic carrying capacity and permeability per unit of area and cost.

The aim in this paper is to point out some of the advantages of wrought iron over cast iron for the field magnet frames of bi-polar dynamos.

The researches of Prof. Ewing and Dr. Hopkinson show that the same magnetizing force per unit of length, as measured in ampere turns, which produces in good hammered scrap iron a magnetization of 100,000 lines per square inch, produces in good gray cast iron only about 42,000 lines per square inch, and these values are about as high as we can go in either of these metals and get anything like a proportionate increase in magnetism for increase in magnetizing force. If, then, the same number of ampere turns are to be used for a given length of magnetic circuit, cast iron must be about two and a half times the section of wrought iron. Since the field magnet, to have the same magnetic carrying capacity at the same permeability, must have about two and a half times the section when made of cast as when made of wrought iron, the weight of cast iron for the same type and capacity of machine will be about two and a half times that of wrought.

In order to compare the relative amounts of copper required in field magnet windings for machines of the same capacity, but with different metals in the field magnet, the same wattage or exciting current must be assumed for all types.

Take two machines of the same type and capacity, with the same length and section of air gap between the armature core and pole pieces and let one field magnet be made of wrought and the other of cast iron, throughout, each having the field magnet core circular in section and the area of the cast iron core two and one-half times that of wrought. Since the ampere turns required on each magnet are equal, also the watts expended in winding, there will be the same number of turns of wire on the cast iron as on the wrought iron field. As the two field cores are circular in section and one two and a half times the area of the other, the length of wire required around the cast iron will be to that around the wrought iron core as $4\sqrt{2\tfrac{1}{2}} : 1$.

Since the weight of copper required to transmit a given amount of electric energy at a given pressure and loss varies as the square of the distance, the weight of copper on the cast iron will be to the weight of copper on the wrought iron core as $\left(4\sqrt{2\tfrac{1}{2}}\right)^2 : 1^2 = 2\tfrac{1}{2} : 1$.

The general practice among American manufacturers of bi-polar dynamos and motors is to use either cast iron entirely or cast iron yokes and pole pieces and wrought iron cores. In the latter case the sections of the cast iron parts are usually made only about one and a half times that of the wrought iron. With these proportions between the wrought and cast iron either an excessive amount of magnetizing force must be expended to drive the magnetism through the pole pieces and yokes, or else the wrought iron core must be only saturated to a very low degree. The amount of copper or field current must be, in either case, considerably increased above that required when the cast and wrought iron parts have their correct relative proportions. Magnetic leakage is considerably increased by the use of cast iron, as compared with wrought iron, by reason of the greater surface of the cast iron, also the much higher relative degree of saturation at which it is frequently used. It is evident that the weight of iron and copper for the field magnet and winding in a machine of given capacity are both more than twice as great when cast as when wrought iron is used entirely.

When the field magnet is made partly of cast and partly of wrought iron, the increase of iron and copper is not so great and varies with the relative section of the cast and wrought iron parts.

The advantages of wrought iron over cast for the field magnets of bi-polar dynamos seem to be more generally appreciated in England than with us, as nearly all the leading makers of such machines there use forged wrought iron entirely for field magnet frames.

As the relative magnetic values of wrought and cast iron become more generally appreciated by dynamo builders in this country, the former will, no doubt, be much more generally adopted.

The following data of a two horse power 110 volt motor power, designed by the writer, and having a forged wrought iron field magnet throughout, may be of interest as illustrating some of the above points.

Type of motor, bi-polar.
Type of armature, smooth core, Gramme.
Weight of motor, 250 pounds.
Speed of armature without load, 1,700 revolutions per minute.
Turns of wire on the armature, 360.
Size of wire on the armature, No. 15 B. & S. gauge.
Weight of armature wire, $3\frac{1}{2}$ pounds.
Resistance of armature, cold, $\frac{12}{100}$ ohm.
Resistance of field coil, cold, 140 ohms.
Current in field coil, $\frac{78}{100}$ ampere.
Wire in field coil, 26 pounds No. 21 B. & S. gauge.

Particular attention is called to the number of inductors on the armature of this machine, namely, 360, which is very small when its weight and the moderate speed at which it runs are taken into consideration.

It is very evident that these results could not have been obtained had cast iron been used, either wholly or in part, for the field magnet.

It may be pointed out that the weight of wire and the energy required for field excitation might have been considerably reduced had it been thought best to reduce the length of the air gap, but it was desired that the field exciting force should practically overcome the tendency of the armature to distort the magnetic field in the air gap, which result has been obtained by the above construction, so that no change of lead, with the brushes, is necessary when the load of motor is varied from nothing to its full capacity.

1. Read before the National Electric Light Association, St. Louis, Mo., February 15, 1893.

Morals of Corporations.[1]

BY E. A. ARMSTRONG.

A corporation is best defined by saying it is an artificial person, possessing certain limited rights, powers and privileges with a life, varying in each case, from a few years to perpetual existence. I did think at first that I would give some of the more elaborate legal definitions which we have of them, but it occurs to me that possibly the one that I have given is as good as I can do; and indeed it fully describes them.

That there is a popular distrust, if not actual hatred, of corporations as such is undoubtedly true. I have thought more or less upon this subject, and if called upon to give my reason for the first origin of this hatred or distrust, I would remind you how they were first created, would ask you to remember the time when the king's letters patent, his seal and writing, made the charter; what special powers, privileges, liberties and immunities were given, and for what purpose and upon what consideration; many of them, like ancient titles of nobility, not being able to bear investigation, and then ask you if you needed further search?

A corporation of to-day, however, is vastly different from any of these, or indeed of those not half a century old. In most of the states, I apprehend their creation is very similar to that of my own state, New Jersey. With us corporations are formed under general laws passed for particular classes, insurance companies, religious societies, beneficial organizations, hospitals, lyceums, libraries and miscellaneous business corporations, all having their respective acts. A corporation, under any of these acts, may be formed for the desired purpose by making and filing articles of association setting forth the prescribed requisites. When this is done, by operation of the law, a corporation is formed. For many purposes only three persons are required. There is no charter, no grant, no executive, legislative or judicial act required. To be sure I speak of the present. Before 1875 it was possible to obtain a special legislative act of incorporation. Now, a corporation being created this way, is it just or reasonable that it be condemned *per se?* I cannot think that it is, because the inherited antipathy is both unjust and unreasonable. It is not, nor can it properly be, a class condemnation even should individual cases merit it.

If there is to be any great work carried on—charitable, religious or educational—what is the first agency we employ? Association, to be sure, by means of incorporation. We would not think of undertaking it without this agency. It puts the little, insignificant and separately powerless portions into one mighty, effective whole, and by it, through concentrated earnest effort, undreamed of results may be obtained. We find it everywhere. Beneficial organizations, life insurance associations, trades unions, all join with one purpose, to get the wisdom, strength and power of aggregation. We are not prone to condemn this, nor should we be. It is a good and glorious thing.

If then, so far I am right, the conclusion follows that a corporation is a desirable and a necessary thing to accomplish the greatest good with the least expenditure of energy and wealth; if what I have said does not prove that to your satisfaction, I shall want you, for the sake of my argument, to assume with me it to be proved, for I propose so to consider it. Now, then, comes my application, and I propose to consider it in two aspects. The first are the moral obligations from a corporation to the public, first, and then to the individuals composing the public. The second are the moral obligations to a corporation from the public, first, and then from individuals, as they can best be considered

1. Abstract of a paper read before before the National Electric Light Association at St. Louis, Mo., March 1, 1893.

together. I shall not formally group or place these two headings, but run them together. Nor do I propose to deal with corporations generally; but as this is the National Electric Light association, I propose to consider electric light companies particularly.

The quasi-public character of much of the business of almost every electric light company in its dealing with municipal authority must be emphasized. Every company doing such service occupies such a position of trust as to require it to give a maximum of service at a minimum of cost. Don't misunderstand me. It is not only the privilege of an electric light company to receive, it is its duty to demand, fair compensation for what it provides and furnishes. It is just as dishonest for it to take advantage of its position and crowd the municipality as it is for the municipality to reverse the tables. We have often taken occasion to complain of the unfair treatment given companies by municipalities, but too often the treatment has been invited. When a corporation such as ours makes a large investment for public lighting, and while it continues to regard what I have indicated as its duty regarding service and charges, it has the right to expect a continuance of the municipal patronage, I was about to say—service, I will substitute. Any deviation from this, while not a violation of an express, is the violation of an implied, contract: something in law just as binding when defined, and, therefore surely ought to be in morals.

I imagine I might amplify this to a considerable extent, but I will not, further than to say what applies to corporations acting with each other and with individuals, as may hereafter be stated, will all apply, and really with more binding force, upon the relation with the municipal or governing corporation. Such a corporation being a part of the governing machinery, it is bound in law, as well as in justice, to treat with absolute fairness every person alike. It is dishonest for it to take anything for public use from its citizens at less than cost. When that is accomplished, that most undesirable of all things, municipal ownership of electric lighting plants, will be undreamed of and unconsidered. No matter how Utopian may seem the idea of the government doing everything possible, it is the idea most foreign to our notion of government—especially the American idea. Everything possible is to be left to the people, with as little government as possible. A despot could administer the government of this country much more effectively and economically than we do by our cumbersome representative system, pervading every department as it does, assuming his honesty, good will and ability; but it would prove far from satisfactory, to be sure. We prefer to govern ourselves, although we may not do it so well and it does cost us much more.

Such, briefly, is the way in which our corporations and our governments should regard each other, as I take it: they should be mutually regardful of the duties and responsibilities of each other and properly regarding their reciprocal obligations, each one can further carry out the argument to his satisfaction.

That there is, to a wonderful extent, this appreciation of obligation on the part of the companies, is a thing very pleasant to contemplate. If accident or disaster happens to a company, just see what heroic effort is put forth to remedy it. Men and money are never spared. The inquiry is made, Can it be done? And if it be answered affirmatively, immediately comes the decree: Then do it. A notable instance of this, the latest of many coming under my observation, be it said, is that of the Buffalo plant. Our friend and former president, Mr. Huntley worked with more than his accustomed vim and vigor to make his plant a phœnix, and did it because his first desire was to serve his city.

How then should corporations regard each other and regard individuals? As I take it, the obligation of the golden rule: "Whatsoever ye would that men should do to you do ye even so to them," is none the less binding upon man in the aggregate. "A man's a man for a' that." He is simply occupying another relation. Now, no matter to what length I carry this paper, I cannot say more than I have said in the statement of this.

It is the duty of our corporation to use the best method it knows or can learn, adopt all the improvements, and render the best possible service, and that at as reasonable a figure as it can afford to do it, having a just appreciation of the risk the capital invested sustains, which is entitled to an adequate return. If you can furnish light or power at a less figure than you are now receiving, and still pay your stockholders a fair return, it is your bounden duty to voluntarily reduce your prices, so that those who make your business possible may have their share in your prosperity.

Don't try and find the maximum your customer will stand, but find how little you can afford to charge him, and deal with him on that basis. He will soon find it out, and it will pay you better than the other course, if that should be your highest aim.

Honesty is the best policy indeed; and by it I mean honesty in its fullest and broadest sense. You may be able to push and crowd your customers and get big prices for awhile; but his turn will come after a season, and then there will be no need for you to ask the rocks to fall on you and hide you for he will attend to all of that. At that time what shall avail you all your former high prices? My plea in this is, regard the golden rule. It pays in the long run.

So far as I have been able to learn from observation, central station companies of themselves have been very considerate and mindful of each other. The poaching has been at a minimum. To be sure, I exclude from this entirely the assisted and inspired organizations that masquerade under the name of local companies. This amicable and creditable feeling is, as I take it, largely due to this association and our electrical papers. The more people know and learn the more tolerant and less bigoted are they. The world is not nearly so bloodthirsty as it was a century or even a generation ago. In all things it seems as if we were more nearly approaching the millenium.

There is one branch of this subject I have not named, and that is the attitude of the parent and supply companies toward the companies of our association. They, of all people, ought to have regard for us. Indeed, they have in times past had the greatest regard for us, in fact, quite an absorbing regard. Too often, indeed, it has been the fabled regard that the wolf had for little Red Riding Hood.

Relation of Insurance to Electric Lighting and Power.[1]

By William Brophy.

Those engaged in insurance business and those engaged in the manufacture and sale of electric lighting apparatus, as well as those who furnish electric light and power, have one common end in view, viz., to secure at least a fair return on the capital invested in their business and for their own time and labor. Each of these interests needs the help of the other and there is no good reason why one should antagonize the other. That this has been done in the past I will not deny, but to say that the insurance companies were wholly to blame for their hostility to the introduction of the electric light would be manifestly unfair, to say the least. Insurance companies have paid dearly in the past for the mistakes of those engaged in the introduction of all modern forms of artificial illumination and many forms of heating.

With the crude methods at first employed for the transmission of the electric current from dynamo to lamps and circuits, fires of more or less magnitude were quite frequent, with consequent loss to the insurance companies. These unfortunate happenings did not tend to cause them to look upon this new candidate with unqualified favor. On the contrary, many were inclined to look on a building equipped with electric lights as worthy of a place on the "prohibited list," while others viewed them as extra hazardous and not to be eagerly sought for by local or special agents even at a very high rate of premium.

How to deal with this new and to most people's minds dangerous element was a most serious question with the underwriters of this country. To many it seemed best to increase rates all along the line where it was introduced, and thus prevent or discourage its use. Had such action been taken there is no doubt but it would have had the effect of retarding the growth of the electric lighting business very greatly indeed. Fortunately this last expedient was resorted to in only a small portion of this country.

The inspector, instead of assuming a knowledge which he did not possess, for the sake of increasing his own importance in the eyes of those who employed him, kept in touch with those whose daily experience enabled them to detect any inherent weakness in the devices and systems of transmission. This enabled him to assist in perfecting the same by advocating all improvements that increased the safety and did not impair the efficiency of the system. In this way the standard of safety has been raised to a degree that approaches perfection, and fire losses caused by electric current decreased, notwithstanding the enormous increase of electric light, power and railway business, and the fears of the insurance companies were in a great measure allayed. In marked contrast with this mode of procedure is that of certain insurance inspectors and others who are now engaged in an attempt to undo all that has been done to bring about an era of good feeling between these two great interests and enable them to work together harmoniously. This attempt at mischief-making is all the more reprehensible, owing to the progress that has been made toward harmonious relations at a meeting of your representatives and those high in the councils of insurance associations. With the exception of one or two of those present at that meeting, all expressed themselves in the most friendly terms toward those engaged in the electric business, and desired to cultivate this feeling of friendship.

In the city of Boston the Board of Underwriters has for a number of years maintained a system of electric light inspection, paid for by assessments levied on electric lighting companies, also on firms and individuals engaged in electric construction. The city is compelled by state law to maintain a similar system of inspection. In addition to this, one of the electric lighting companies, whose officers are not possessed of an abiding faith in either of the above named systems of inspection, makes it a point to inspect all wiring before they will connect thereto. Yet with all these safeguards and checks on those engaged in electric lighting and construction, some men "claim to see a connection between the growth of the fire loss and the growth of the use of electricity." The real fact in the case is that millions of insurance has been placed by the agents and brokers on property that is far more hazardous than the very poorest electric light plant in the business portion of the city in question. Ordinary prudence having been thrown to the winds in writing such insurance, the inevitable consequences of such folly ensue, viz., disastrous fires. The agent who sees a possible loss of commissions hastens to give a plausible excuse to his companies, by charging the origin of the fires to electricity and demands an investigation of the fire department for not extinguishing them before they were kindled, concealing the fact that his own methods of placing insurance encourage incendiarism and promote carelessness.

In view of the fact that it is now proposed to add a small charge to the rate of insurance where electric lights "are installed in compliance with board rules and specifications," and a charge of 25 cents where they do not meet with the approval of the insurance inspector, I would advise you to pursue the following course: Where a company does its own wiring for its customers proceed with as much care as though the building in which you are installing wires and fixtures was your own, and you had no insurance on it. Where the work is done by others, inspect every foot of wire, every joint, cut-out, switch and insulator, and on no account turn on current until you are satisfied that it is as safe as it is possible to make it. Do not rely on the uncertain movements of the insurance inspector or any other system of inspection that too often fails to inspect. You are the one whose business will suffer from the bad effects of fires caused by defective wiring.

We now come to the electric light station. Do not rent one end or the basement of a flour, saw or planing mill and place your machinery in it and expect to get any better than the rates charged on the buildings named above. While they are considered extra hazardous risks, insurance boards in their wisdom(?) will tell you that the introduction of electric light machinery increases the hazard and also the rate. This statement may cause you to smile, but there are those who, by early experience, have found it no laughing matter. Do not place it in some old abandoned building, for, as in the above case, an increase of rates will follow. Do not set your machinery down on the ground and build a tinder box around it, for besides assuring high rates of insurance it does not speak well for the business sagacity of the owner. Proceed as though you proposed to do a legitimate business and for all time. Build your station on solid foundation, the walls of brick or stone, not over two stories high—better only one—solid brick or stone foundations for engines, boilers, dynamos and pumps; a solid brick wall extending three feet above roof between boiler and engine room; the floor of boiler room of brick, stone or cement; if building is two stories high, have the boiler room the same, having clear, open space between floor and roof; floors of engine room, if dynamos are not placed therein, can be of iron or stone; if dynamos and other apparatus are in the same room, floor should be three inch plank, tongued and grooved, with hardwood floor of one inch boards, matched and laid at right angles to, or diagonally on, the plank, the whole laid on heavy square timbers or iron I beams; the roof should be of three inch plank, splined and grooved, resting on square, hard wood timbers or trusses or iron or I beams; cover this with slate, tin or gravel, according to pitch; leave the walls bare; do not attempt to improve their looks by covering them with wood, creating concealed spaces; roof and ceiling, ditto; enclose stairways with plank, and provide self-closing doors therefor; cover the doors in brick partition walls with tin; also the frames; do not build a wooden hen-coop or Turkish pagoda on top of roof, and call it a wire tower; build from floor of dynamo room, of brick or tile, a good substantial tower, of ample size for all wires; put them in systematically and not by guess; make switchboard of good hard, well seasoned wood, skeleton in form, or use the sides of brick or tile tower; if slate switch-board is used, bush all holes through which wires, plugs or other connections carrying high potential currents pass, with glass, porcelain or hard rubber; do the same if sides of brick wire tower are used; use this same material where wires pass through floors or other woodwork; secure a supply of water for protection against fire from town or city mains, if available and pressure is sufficient. In doing this have pipe leading into station of ample size. It costs no more to excavate for a six inch pipe than it does for a one inch, and the difference in cost of pipe is not enough to outweigh the value of an abundant water supply in case of fire, for, like the Texan's revolver, then is the time when you want it and want it bad. If water connot be secured in this way, make your boiler pumps sufficiently large to throw, when connected together, or working singly, from three to five hundred gallons per minute, according to circumstance. Remember that all electric apparatus, including dynamos, is very susceptible to damage by fire or water, and by reducing the amount of combustible material in your plant you reduce the possibilities of a large fire and the necessity for a large amount of water.

Do not, if possible, build your station adjoining or too close to such risks as oil refineries, planing, saw or flour mills, grain elevators, etc. If obliged to do so, have no, or as few openings as possible in the exposed side or end, and provide metal covered shutters for these few. Run all your wires in plain sight, leaving ample space between them.

In planning your station, allow for future growth and enlargement, without disturbing the present arrangement of machinery, etc. Store your oil, and if possible your other supplies, outside the station, and if you have a repair shop, do not have it in the second story, attic or basement. It is much better outside the building. If you must have it in the building, do not box it up out of sight, but separate it, if you must, by an open partition or fence from the rest of the building. Divest your own mind of the idea that dirt, grease and slush must be the wedded partner of an electric light station, and impress on those of your employes that an absolute divorce must be granted if the marriage ceremony has been performed. "Cleanliness is next to godliness," but nowhere does this maxim apply with such force as in an electric light station.

Having finished your plant in accordance with the foregoing requirements, you need have no fears of acts of unneighborly conduct or apparent neglect of your property by the ever active insurance agents. Instead

1. Abstract of paper read before the National Electric Light Association at St. Louis, March 1, 1893.

of waiting for you to seek them out and beseech them to insure it, they will be as attentive to you as the most ardent young suitor ever was to his ladylove. Remember that so-called tariff rates and agreements, that hold insurance associations together for the purpose of maintaining high rates, are but ropes of sand, and that keen weapon, active and oftentimes bitter competition, is continually cutting it up in little pieces and letting this craft, that should be rightly named "Trust" drift on the hostile shore of independent action.

DISCUSSION.

W. J. HAMMER: It seems to me, in view of Mr. Brophy's remarks, and it is possible a closer union could be established between the National Board of Fire Underwriters' association and the men who are actively engaged in the electric lighting enterprises, by having a joint committee, composed of members of the National Board of Fire Underwriters' association and of the National Electric Light association, to compare notes and issue a joint report.

MR. BROPHY: I have no objection to any rule that may be made by the Board of Fire Underwriters, so long as they do not exact undue concessions or place undue restrictions on the business. I have lately come into possession of certain rules issued by the National Insurance Board. They vary but slightly from the rules issued by this association. I suggest that our standing committee on safe wiring before the next meeting compare these rules, and if possible work in harmony with the insurance companies.

A. J. DE CAMP: I think the rules adopted at the Montreal convention were good rules, but we should have rules which would not operate unjustly in some cases, as any set of rules rigidly adhered to are sure to do. It has therefore occurred to me that it might be a good plan, instead of having this committee meet to consider and adopt these rules, to have it resolve itself into an arbitrating committee to adjust differences and inspect work.

The "Vulcanizing" Process for Preserving and Strengthening Poles, Cross-arms, Ties, Etc.[1]

BY HARRY C. MYERS.

When we consider that the annual consumption of timber in this country equals twice the amount of material supplied by the annual growth of our forests, it is apparent that the subject of wood preservation, wood strengthening and the utilizing of certain woods now considered as worthless, is a most important and vital one.

Wood as it occurs in nature consists of cellulose impregnated with resin, volatile oils, sugar, gum, tannin, protein bodies and the usual mineral constituents of plants. The percentage of these various constituents, of course, depends not only upon the kind of wood, but upon the season of year, locality, nature of the soil, and part of the tree from which any given sample is taken, hence any results or tests would be only approximate ones.

When wood is heated, as in ordinary wood distillation, the cellulose decomposes and a chemical change takes place between it and the natural constituents of the sap, resulting in a most powerful antiseptic mixture containing acetic acid, methyl alcohol, acetone, methyl acetate, tarry matter containing phenol creosote, carbolic acid and about thirty other chemicals of lesser practical importance.

The following percentages by weight were distilled from various woods:

Yellow pine	57.8 per cent.
Norway pine	56.8 per cent.
Virginia pine	60.2 per cent to 72.1 per cent.
Red oak	55.3 per cent.
Spruce	58.7 per cent.
White pine	61.2 per cent.
Poplar	59.0 per cent.
Cypress	59.0 per cent.

It must be borne in mind that these chemicals and antiseptics result from the action of heat on the natural sap of the wood, and are entirely different from the original sap, which allows of the attacks of microscopic fungi and decay. Why has it occurred to no one to heat timber at a temperature which would produce the change, and then to keep the changed antiseptic mixture there under pressure instead of distilling it out of the wood? Such is the entirely new and original process known as "wood vulcanizing," viz., the heating of wood and timber under great pressure.

Hundreds of processes for preserving wood have been patented, and all of them may be divided into two classes: I. Those in which wood is impregnated with a preservative material by immersion. II. Those in which a preservative agent is forced into the pores of wood. Such chemicals as copper sulphate, zinc chloride, mercuric chloride, dead oil, etc., have been applied, but experience and results have failed to prove them all that is to be desired in an economic and effective means of wood preserving. The poisonous nature of such chemicals makes the application and use of them very objectionable.

In the process of vulcanizing, wood is heated in closed cylinders from eight to twelve hours at a temperature ranging from 300 degrees to 500 degrees Fahrenheit and under a pressure of from 150 to 200 pounds to the square inch. A circulation of superheated and dried compressed air removes the surface moisture and any water that does not take part in the reaction and combine with the woody constituents. Hence, wood or timber, in any condition, may be immediately treated. These cylinders for the treatment are 105 feet long, 6½ feet in diameter, and are made of steel. As the treatment penetrates to the heart of the timber, considerable time is required for cooling, which is, of course, done in the cylinder and under pressure. Timber is introduced and treated upon cars which run into the cylinder upon small tracks. The percentage of dark antiseptic matter contained in vulcanized woods I find to be as follows:

Vulcanized yellow pine	55.3 per cent.
Vulcanized Norway pine	56.7 per cent.
Vulcanized Virginia pine	58.9 per cent.
Vulcanized red oak	54.0 per cent
Vulcanized spruce	57.9 per cent.
Vulcanized white pine	55.5 per cent.
Vulcanized poplar	59.0 per cent.
Vulcanized cypress	56.8 per cent.

The samples from which these results were obtained were companion pieces to those from which the previous results were obtained; a comparison shows the percentage of moisture removed by the vulcanizing process.

This process apparently makes decay impossible by sealing up the pores of the wood with antiseptic matter, which becomes solid and firm on cooling and standing, and which is produced within the wood by the action of heat and pressure upon its original sap.

The original sap is colorless or pale yellow, and the changed sap very dark or black, hence a most desirable dark antique color may be imparted to oak and other woods.

The following tests were made at the School of Mines, Columbia College, by request of the Western Union Telegraph company, upon cross-arms to be used on telegraph poles

In each case two cross-arms were made from the same piece of timber; one was vulcanized and the other left untreated. Results give, in pounds, the weight required to break each cross-arm:

Vulcanized Norway pine	3,000 pounds.
Natural Norway pine	2,680 pounds.
Vulcanized cypress	2,600 pounds.
Natural cypress	1,860 pounds.
Vulcanized spruce	2,780 pounds.
Natural spruce	2,460 pounds.
Vulcanized poplar	2,840 pounds.
Natural poplar	2,560 pounds.

These startling results show an average increase in strength of 18.9 per cent. Similar tests made by Prof. R. H. Thurston and Prof. Alfred Trautwein of Stevens Institute, verify the above results.

The Hon. B. F. Tracy, secretary of the United States Navy, with a view of adopting vulcanized wood in naval construction, appointed a committee which visited the vulcanizing works in New York city, made tests of its own on yellow pine, showing an average increase in strength of 18 per cent. and a decrease in deflection of over 13 per cent.; hence, it reported that vulcanizing increases the durability and strength of timber, and recommended such timber for use as backing in one of the monitors.

Untreated cross-arms which had been painted and used by the Bell Telephone company for from two to three years showed, by actual test, an average decrease in strength by exposure of 18.78 per cent., as compared to new untreated cross-arms. Other pine cross-arms which had been in service on Western Union telegraph poles for three years and over showed an average loss in strength by exposure of 38.12 per cent. The process of vulcanizing seasons all timber, thoroughly preventing any further warping, checking or cracking. Such timber is not influenced by atmospheric agencies, bacteria or spores, and requires no paint for protection, as it is saturated with antiseptic preserving material of its own; the albuminous constituents of the natural wood have been coagulated by the high heating and rendered insoluble. Loblolly pine, as it is used in the South, decays in about three years, and is unfit for any railroad construction where it is exposed to the elements.

This timber when vulcanized is as durable as ordinary timber and ties used in railway construction. Other woods are seasoned and rendered beautiful by vulcanizing, which produces very desirable colors for interior decoration.

The life of vulcanized timber is not known; none of the timber or ties used in railway construction during the past ten years have been known to decay. I personally examined some 12 by 12 pine timber which had been placed in a machine shop in 1882, part being vulcanized and part untreated. The treated timber is perfectly sound and still in use, while the untreated had completely rotted and crumbled away after five years' use. I also find by personal investigation that timber placed on the Manhattan elevated roads of New York city, as far back as 1883, shows no signs of decay, and is as sound and sweet as if fresh from the tree, while untreated timber laid at the same time has rotted away and been replaced.

As vulcanizing changes the sap from the liquid to the solid or semi-solid state, does not char or make the wood brittle, saturates and seals up the pores of timber with solid matter instead of liquid soluble matter which nature provides, considerable strength and durability are added by vulcanizing, the wood being rendered more cohesive, harder and denser. The spike holding quality is naturally much increased, and even after ten years' service, railroad spikes seem to be as firmly imbedded as when just driven.

It is also a curious fact that the electrical resistance of most woods is very greatly increased by vulcanizing.

Hampton Roads, Va., is rapidly becoming encircled with electricity. Old Point, Hampton, Newport News, Norfolk and Portsmouth are all lighted by electricity, and as soon as a few missing links are supplied the electric transportation chain will entirely encircle that wonderful body of water, where the war vessels of the world will meet next month on peaceful mission to celebrate the 400th anniversary of the discovery of America.

Underground Conduits and Conductors and the Experiences of Electric Lighting Companies of New York City.[1]

BY WILLIAM H. BROWNE.

Those who are intimately acquainted with the histories of electric lighting companies of New York city may be pardoned if they believe that the experiences undergone by those companies have been unique, and that they afford to companies elsewhere opportunities for beneficial consideration. In the years 1880 and 1881, but twelve or thirteen years ago, two companies began in New York city the business of distributing electric current from central stations for public and private illumination, the one using the Brush, the other the United States system of arc lighting. In the year 1884 manufacturers of other apparatus saw in New York city a field of profit and advancement for their machinery. In that year, franchises were granted to six other companies, all of them primarily intended for arc lighting. Some of these companies, taking note of the numerous poles that were in existence for the telegraph, telephone, police and fire department service, deemed it uneconomical to erect poles for their own wires, but arranged with those having charge of such poles for the attachment of the electric light conductors on those existing poles. Some of the companies created in that year did not make rapid progress, and the increase of poles and wires for electric lighting was not materially appreciable until 1888.

During those years, however, the wires for telegraph, telephone, messenger service, police and fire alarm had increased rapidly and became so numerous and filled the air with so many strings of iron, that the public eye became offended and bills were introduced in the state Legislature looking to the burial of those wires. The electric light wires were so few as to be scarcely noticeable, and did not attract attention.

In 1884 a bill was passed in the Legislature directing that the wires be removed from the streets before the first day of November, 1885, but it provided no means to insure their removal, nor penalties for non-removal. The Legislature of 1885, having found that the previous enactment had accomplished nothing, passed another act which provided that "if no suitable plan should be proposed for placing the wires underground, it should be the duty of the board of commissioners to cause to be devised and made ready for use a general plan to meet the requirements of the acts of 1884-5, and that the board should have full authority to compel all companies to use the subways prepared." Under this act the subway commissioners, who had not been provided by the act with funds wherewith to carry out the object named in the act, deemed it wise, in order to carry out the purpose of the enactment, to make a contract with some company to build the subways, and this was done in 1886.

Persons interested in the telephone company realized that the purpose of the act would inevitably be carried out; and as the interest of that company in the fulfillment of this purpose would be affected to a greater extent than any other, except possibly the telegraph company, it deemed it prudent to become interested in the company with which the subway commissioners had made the contract for the construction of subways. This secured to the telephone company a right of way of almost incalculable value. Even at that time the place and method of burial of electric light wires was scarcely considered. Some approaches were made to the two old companies engaged in electric lighting, as to their taking upon themselves the task of building subways for electric lighting purposes; but they, it appears, chose to refuse to entertain the propositions.

In 1888 began the introduction of the alternating system of incandescent lighting. Until that year electric lighting had been confined almost exclusively (of course, outside of the low tension company) to arc lighting; and the increase in the business to that time had not required the multiplication of wires and poles to any considerable extent. In 1888, however, four companies began a spirited effort for the introduction of incandescent lighting with the result of contracting for upwards of 60,000 lights within less than a year. This caused a considerable increase of wires. The wires were strung principally upon the poles previously in use. Comparatively few new poles were erected, until in the latter part of 1888, the Board of Electrical Control, recognizing the increase of electric lighting, formulated rules for the extension of that business by means of overhead construction, and in order to provide the best possible overhead construction prescribed certain requirements under which, with the immediate supervision of the Board of Electrical Control, what has probably been the finest line in the world was erected. It was considered an ideal line. It consisted of poles 85 feet high, 16 to 20 inches in diameter at the base and not less than 8 inches at the top. On this line were strung something like 150 wires, none less than No. 4—the majority No. 2. The poles were made tall so that the wires might not interfere with the operations of the fire department; and if breaks should occur between poles the wire could not reach pedestrians, and also to avoid the numerous crosses with the other wires, which were the source of much trouble. To further secure these results the cross-arms were placed at the highest part of the poles. Experience soon suggested that this mass of weight must be reduced from the top, and they were carried down 15 or 20 feet. This precaution was, however, not sufficient, as in December, 1891, a section of that line, about a mile in length fell into the street.

1. Abstract of paper read before the National Electric Light association at St. Louis, Mo., March 9, 1893.

During 1888 the companies having aerial lines in upper Broadway, the principal thoroughfare of the city, were directed to place cables in the conduits which had been prepared in that street and to remove their overhead construction. But the companies objected strenuously. They declared vigorously that it would be impossible to operate currents of high tension underground. They were supported in this contention by professors and others learned in the art. They appealed to the court to be sustained in this position.

The then mayor of the city, also, by virtue of his office, president of the Board of Electrical Control, agreed substantially with the companies and opposed his fellow members.

The controversy became heated and to a great extent personal. In fact so much so that the mayor refused to sit with the other members of the Board of Electrical Control.

The courts declared that the law gave to the Board of Electrical Control the power and the right to decide whether the subways were fit and proper for the purpose, and ruled that the companies must comply with the law and occupy the subways with their cables and remove their overhead construction.

In August, 1888, the first effort was made to use the electric light subways on Broadway, from 14th to 35th streets. The subway company had invited the companies to make the experiment of operating high tension current underground and offered the use of the subways without rental for the experiment. The first cable was placed for arc service and consisted of eight conductors, insulated from one another and enclosed in lead armor. The experiment with this was not successful. The cable did not meet the requirement of the Board of Electrical Control of an insulation resistance of fifteen megohms per mile for each 100 volts for each conductor. This result seemed to verify the claims of the companies that arc lights could not be served from underground conductors, under the conditions imposed and existing.

The opposite view was maintained, however, by the Board of Electrical Control and the subway contractor, and the courts having held that the law accepted no other decision than the opinion of the board the companies were threatened with the removal of their aerial wires in the localities provided with subways whether they placed cables in the conduits or not.

The year 1889 brought a new mayor and president of the Board of Electrical Control. He immediately promulgated the order that within ninety days the wires must be removed by the companies from streets provided with subways or he would exercise the right given by the law to have them removed by the city.

At that time two other companies undertook to make a test, one to the extent of one block on 125th street; the other of a circuit of twenty-one blocks on Broadway and Sixth avenue for ten arc lights.

Controversies and contentions between the companies and the authorities had become so animated that the companies were not credited by the authorities with being disposed to have the experiment succeed, and although they laid their cables with all attainable speed, and were successful in the tests and announced their intention to occupy the subways as rapidly as they could, no extension of the ninety days was granted, but on the 5th of April, 1889, the authorities began the cutting down of the electric light aerial lines on Broadway and Sixth avenue, where the subways had been provided.

This action aroused great excitement in the public mind and the authorities were applauded by the newspapers for their vigor. The occurrence of several accidents, principally to employees working on overhead lines, added opportunity for furtherance, by sensational articles in the newspapers, of the excitement, so that the Board of Electrical Control (which in the preceding year had devised the rules under which the large line, heretofore referred to, was erected, and which had supervised its construction and believed that by it a way had been found to provide for the extension of electric lighting and carry out the provisions of the law under which the commission was established, without excessive construction of subways), objected wholly to the use of aerial lines for electric lighting purposes, with the result that in October, 1889, it declared destruction practically to all the lines in the city, except the one built under their guidance the year before, and ordered the construction of subways with what can now be undoubtedly considered erroneous judgment and with undue precipitation.

Concert of action between the authorities and the companies; careful deliberation of the probable requirements and the energy which makes haste slowly but correctly would not have produced, it is true, the removal of the overhead lines to the extent that was accomplished within practically two years; but also it would not have produced the extraordinary expenditure of money, both by the subway company and the electric lighting companies, nor the loss of business and disturbance that occurred to the companies; but it is fair to presume that a somewhat different condition of the subway situation and of the electric light companies would have been effected with material benefits to all financially interested.

There have been built for high tension electric lighting 600 miles of ducts. Of this about 260 miles or 42 per cent., are rented by the companies. Included in the amount stated as rented by the companies are about 50 miles not occupied yet with cables. These ducts so rented and not occupied are the result of a rule passed by the Board of Electrical Control in 1890, in deference to the wish of the Department of Public Works, that wherever streets were to be repaved subways must be built previous to the paving or they would not thereafter be allowed, and companies failing to make application for conduits in such streets at that time would be deprived forever after of the opportunity of obtaining accommodations in those streets for the transaction of their business. They were further required, in making application for such accommodation, to give a bond securing the occupancy of, and payment of rental for, such ducts as were so constructed for five years from the date of completion. This rule was subsequently enacted into a law by the Legislature. Under that rule the companies applied for the construction of subways in anticipation of the future, and not for immediate need.

At the present time there are, therefore, occupied with cables only about one-third of the ducts built. Instances of subways built in excess of requirements, as developed to the present date, may be noted. On Broadway there are 200 miles of ducts, of which but eighty miles are occupied. On Third avenue 142 miles, but 41 miles occupied; on 23d street, 34 miles built, 11 miles occupied, on 29th street, 28 miles built, 17 miles occupied. It may be considered a very reasonable calculation that the increase in the occupation of subways on those streets will never require all the ducts built.

The 600 miles of ducts occupy only 78 miles of streets. The number of miles of ducts, therefore, in any street occupied with cables averages less than three miles. With the 600 miles of ducts now built distributed in this ratio, nearly 200 miles of streets would be provided with subway accommodation and the extent of the territory available for the development of the business enlarged to three times its present area. Of the 600 miles of ducts 454 miles were built prior to the year 1890, and included in that construction were the streets already mentioned in which continue to be so large a number still unoccupied.

During the year 1892 24 miles of ducts were built, occupying nearly 10½ miles of streets, or an average of two ducts per street.

If the work could be begun now in the light of present experience, the average number of ducts per mile of street would not probably exceed three. For all kinds of service one duct will provide ample accommodation in the greater portion of the city.

The 200 miles of ducts occupied with cables are confined to the 78 miles of streets and contain for main cables about 600 miles, or nearly eight miles of cable per mile of street, and an average of about three cables per mile of duct occupied. About 320 miles are used for arc circuits and 280 miles for incandescent circuits.

These cables represent in many instances the occupation of a given street by each of four separate groups of companies, all seeking business and having customers in the same street and often in the same block.

But for this quadruplication of occupancy the mileage of cables at present in use would provide current in a much greater mileage of streets and to a larger number of customers.

The cables are divided into 81 circuits for arc lighting and 50 circuits for incandescent, all the latter being used for the alternating system. One of the arc circuits is about 15 miles in length, several are about 12 miles long, 18 are longer than 8 miles each, and 40 over 5 miles, the average, however, being less than 4 miles. The incandescent circuits average over 5½ miles each.

Connecting these main cables with the premises of customers through the subsidiary subway connections are about 150 miles of cables, so that the aggregate mileage of cables underground is about 750.

The 81 arc light circuits supply about 5,000 arc lights, or an average of about 60 lights per circuit and an average of about 15 arc lights per mile of cable.

The incandescent circuits supply about 90,000 incandescent lights, or an average of about 1,800 lights per circuit or about 320 lights per mile of cable.

In the operation of these 750 miles of cables there have been manifested during 1892 faults of all kinds to the number of 49. Faults are reported to the subway company as soon as discovered. As access to the ducts cannot be had except under the supervision of the employes of the subway company it must be assumed that all discovered are reported. Faults are classified under three heads—"low tests," "grounds," and "burn-outs."

"Low tests" are discovered in the tests which are required weekly of every circuit and mean that the insulation resistance of the cables has fallen below a minimum of 5 megohms per 100 volts per mile, belowwhich it is not permitted to operate a circuit until the fault has been ascertained and remedied. The number of "low tests" for the year were 5 on arc and 6 on incandescent circuits. Two "low tests" were discovered to be in the terminals, one being on an arc, the other on an incandescent circuit. The cause of 3 "low tests," one on an arc and two on incandescent circuits, was not ascertained. Three "low tests" on arc and three on incandescent circuits were discovered to be due to bad joints.

"Grounds" were discovered 16 times on arc and 8 times on incandescent circuits; 8 of the "grounds" on arc and one on incandescent circuits were discovered to be in the terminals. The cause of 3 "grounds" on arc and one on incandescent circuits is unknown; two "grounds," each on arc and incandescent circuits were ascertained to be due to mechanical injury to the cables and 3 "grounds" on arc and 4 on incandescent circuits were discovered to be due to bad joints.

Eleven "burn-outs" occurred on arc and 3 on incandescent circuits; 3 of the "burn-outs" on arc circuits were due to causes not ascertained. Three "burn-outs" on arc and 3 on incandescent circuits were ascertained to be due to mechanical injury of the cables and 4 "burn-outs" on arc circuits were ascertained to be due to bad joints.

Two "low tests" and 9 "grounds" due to terminals cannot be considered as faults of the cables proper. Of the 38 faults discovered in the cables 12 were due to bad joints, 10 to mechanical injuries and 10 to causes unknown, but probably mechanical injury.

The 38 faults of the cables occurred on 25 circuits, so that 106 circuits were operated throughout the entire year without a fault or trouble of any kind. Two of the 25 circuits were each responsible for 5 of the faults, one having 4 "burn-outs" and one "ground" the other 4 "grounds" and one "low test."

It may be said here that the troubles from bad joints occurred usually at the beginning of the use of the circuit and the same may be said to a large extent of the troubles with the terminals. This can be avoided by careful work.

The 9 "burn-outs," 8 "grounds" and three "low tests" due to mechanical injuries or unascertained causes may be considered as the dangers which cannot be guarded against in a system where cables of several companies are in the same manholes, to which employes of each have access, but the experience of nearly four years indicates that this source of trouble is decreasing. From May, 1887, to March, 1889, twelve explosions occurred in the subways; since the latter date none has occurred. No one has been injured from any cause.

Most, if not all, the incandescent circuits are operated every hour of every day, and some of the arc circuits also. Tests are usually made with all connections undisturbed.

Nearly all the current for all the high tension arc and incandescent service transmitted in the city of New York below the Harlem River is conveyed by underground cables. Above the Harlem River the Board of Electrical Control allows the construction of aerial lines, no subways having been built in that section of the city. Below the Harlem River no overhead wires are permitted to be erected and few of those that were in existence remain. It is probable that before the end of this year scarcely any will be in existence. The penendured by the companies for their opposition to the subways have been severe and drastic. The expenses imposed upon them in their effort to take care of their business and meet the requirements of transferring their systems from overhead to underground have been enormous and burdensome. The expenses for rentals, due in a large measure to the amount of subways constructed and not occupied, continue and seem likely to continue to be an onerous task. These expenses and burdens have tended and are likely to tend farther in the future to confine the operations of the companies to territory contiguous to their generating stations, and may also tend to avoid the fierce competition which existed during the days of aerial transmission, and which lowered prices below remunerative rates.

If the subway situation in New York city were not such as it is, and it is such from the causes here suggested, there seems no reason to doubt, in the light of the experiences possessed by all conversant with the situation, that fully as satisfactory accommodations and results to all interested could be accomplished at not exceeding 25 per cent. of what it has cost and with corresponding beneficial conditions, which would prove, at least, not unremunerative to all interests affected.

May it not be concluded, in view of the experiences in New York city, that all aerial conductors are necessarily transitory, particularly in our larger cities?

Is it not advisable for controllers and managers of companies in such places to recognize that condition and endeavor to avoid the experiences of New York companies by planning deliberately the procurement of the right to themselves to build and operate their own subways and further to utilize the experiences of New York to avoid the expensive mistakes there made and to place their business on a stable footing and in a position where they may have immunity from injurious and cheap competition and secure service to their customers free from the interruption belonging to aerial transmission? It is reported that one company in a large city, where no laws compel it to place its wires underground, feels itself forced to seek that method by reason of the fact that the aerial lines are becoming overloaded. Is this not likely to be the case in many other places? The Telephone company finds it materially to its advantage to use underground conductors, and it is doing this in many cities.

Underground conduits and conductors for electric lighting and power provided with due care and deliberation need not increase the fixed charges of companies doing a reasonable extent of business to such an extent as to be prohibitory.

The transmission of electric current is entirely analogous to that of gas, water or steam, and must inevitably be conducted underground as they are. To electric light companies, as to gas, water and steam companies, the legislatures and law makingbodies should give rights enabling them to meet the conditions in the manner calculated to produce the best results for the companies and the public users, and if the above recital of causes and effects, experiences and results in New York city will tend to prepare the way for other companies to avoid the experiences of those of New York city the relator will feel as justified with his effort as he is appreciative of the compliment implied by the invitation of our worthy president which has afforded the opportunity to offer this paper for your consideration.

Discussion.

A. J. DeCamp: In all my conversation with the people who employ electric lighting I have found few, if any, who have made calculation as to what is going to be the difference between the cost of the product delivered to them by overhead as against underground wires. I have heard it said that the underground system of conduits in the city of New York would not pay 1 per cent on the cost of the investment. This work is a quasi-public improve-

ment, and my idea is that it should be done by the city, just as much as the water works, the gas works, or any other thing which enters into the necessities of a great city. Do you think that the taxpayers of the city of New York, if the question had been fairly put to them, would not authorize the construction of these conduits? Unless we increase our prices we cannot stand any such charge as is made against the companies in the city of New York.

M. J. FRANCISCO: There is no question in regard to the feasibility of placing wires under ground. That has been fully demonstrated. It is simply a question of commercial success. At the present time it is almost impossible for a company in a place of 300,000 or 350,000 inhabitants to operate an underground circuit and pay expenses. As a general thing the cost of constructing the conduit would average about $4,500 per mile.

JOHN J. MOORE: The New York situation was brought about mainly I think through the stupidity of the companies themselves. The idea has been advanced that the city should build conduits. I am sorry to hear that. If it can build conduits, why cannot it run wires? In Massachusetts, if the city or municipality wants to go into the business of lighting, it must buy the plants established; it must buy them at an appraisal fixed, not alone on the basis of cost, but of earning power. This is a fair arrangement, and I wish it prevailed everywhere. At the last bidding on lights for New York the companies came forward and said: "We must have so and so; we must have a certain price." The city said they could not get it, and the companies came in with their tails between their legs and said, "we will furnish it at your price."

Thermal Storage for Central Stations.[1]

BY GEORGE FORBES.

When asked to give you a paper on some electric lighting subject, it seemed to me I could not choose a better one than thermal storage for central stations, which had so much attention directed to it lately in England. It has long been evident that storage of some kind might lead to great economy in central station work. The reason of this is that the demand for light has in most cities a maximum for only two or three hours of the day. Not only do we require to have the plant lying idle all the rest of the day, but the expense of working for these few hours is increased by its temporary character. This loss of economy has occurred both in engines and boilers. Underloaded engines are very inefficient and use up a lot of coal. This effect is, however, gotten over in all important central stations by having at least a few engines of small power to carry the day load. We are thus able to have engines in use always working at their most economical load, that is near full load. The other loss in economy comes from the boilers, which have to be fired up and heated for only a few hours' work and then banked or else allowed to cool down. This loss cannot be overcome by working the ordinary plant in any special manner. At the Kensington station, London, where the engines are always working at an economical load, five pounds of coal are used per electrical horse power per hour, whereas in tests of 26 hours' duration, made on the same plant with all the boilers doing full work, only three and a half pounds of coal were required for the same duty. If then we could have storage of any kind by which power is absorbed at times of light load and given off at times of heavy load, we should save one and a half pounds of coal per horse power per hour. Many people have thought that storage batteries would overcome the trouble. It does so, but at an enormous capital expenditure for storage batteries, with a loss of twenty per cent. in the energy given to the batteries, and with a depreciation account which no one would put at a less figure than twelve per cent. per annum.

I have previously proposed that in a hilly country the boilers and engines should be working all the twenty-four hours, at the rate of the average demand, and that they should be used to pump water through a pipe to a high reservoir at least five hundred feet above the pumping station. At the lower end of the pipe turbines are placed driving dynamos. During day time the reservoir is being filled and in the evening it is being emptied. This produces a saving in boilers and the substitution of cheap turbines and a small number of efficient pumping engines for a large number of less efficient engines to drive dynamos. It also reduces the coal consumption from five pounds to three pounds per horse-power per hour. In a paper read last year before the British Association for the Advancement of Science, I showed that this plan could easily be adopted in Edinburg, in Scotland, the saving in capital and annual expenses being both very large. But it is not every city that has these advantages, and I wish now to introduce to your notice the excellent scheme which has been invented by Druitt Halpin, of Edinburgh.

He proposes to put up boilers only of the average capacity and to work them day and night. At times of light load the steam is carried through pipes into large iron reservoirs of cheap construction, and is used to heat the water in these reservoirs to a high temperature and pressure. When the heavy demand comes on in the evening steam is drawn from these reservoirs. The losses of heat from radiation from the reservoirs can be made very small indeed, with proper lagging, in fact quite imperceptible.

This is the general scheme of Mr. Halpin's plan. But it has two advantages which are not so apparent at first sight. One is the purity of the water supplied to the engines. Mr. Halpin's pumps feed water into the hot reservoirs when impurities are precipitated in a [illegible] do no harm. The boilers on the other hand, are fed from this pure water in the reservoirs.

The other incidental advantage of the system is that priming the boilers does not cause any inconveniences, as the steam is supplied to the engines from the reservoirs. Now it has been found from the experience with the water tube boilers which are so much used in this country that only three pounds of coal per hour can be burned per square foot of heating surface, on account of the excessive priming, instead of the six pounds per square foot which we can use with the Cornish or Lancashire boilers, and which might be used with water tube boilers if priming were no objection. Thus it appears that the adoption of Mr. Halpin's system not only reduces the number of boilers that we require, but also doubles the capacity of each boiler.

Mr. Halpin has worked out the relative cost of supplying machinery to the central station of Berlin (1) without any storage, (2) with storage batteries and (3) with thermal storage. He first selected this station because the output at each hour of the day all through the year was published before any other central station had pubished similar data. In this system there are four central stations, giving off about ten thousand electrical horse power.

The load at different times of the day is such as to lead to the following data:

Maximum load	7,500	kilowatts,
Mean load	2,030	" " "
Excess of max. above mean	5 080	" " "
Duration of ditto	7.5	hours.

Now Mr. Halpin claims that he can replace 22 boilers for working in the ordinary way by five boilers and 92 of his storage cylinders, which are cheap to construct and have necessarily a small evaporation. His claim, which I must admit seems to be quite well founded, is that while laying out somewhat more capital on his plan, he gets a very large return for the extra capital spent. He sums up the cost of the thermal storage system as follows:

Five Babcock & Wilcox boilers	$27,050.00
Boiler house	9,500.00
Chimney	4,850.00
Cylinder house	33,300.00
92 Cylinders	184,000.00
Total,	$258,700.00

and he puts the cost under the existing system at $182,700 00.

Now if we charge ten per cent. to annual depreciation of boilers and only five per cent. on iron cylinders, which really seems a very fair value, then the annual interest and depreciation comes out almost the same for both systems, thus:

EXISTING SYSTEM.

5 % on $182,700.00. capital	$ 9,135.00
10 % on $117,850. boilers	11,785.00
4 % on $64,850.00, buildings	2,600.00
Total,	$23,520.00

THERMAL STORAGE.

5 % on $258,700.00 capital	$12,935.00
10 % on $27,050. boilers	2,705.00
4 % on $47,050.00, buildings	1,900.00
5 % on $184,000, cylinders	9,200.00
Total	$26,740.00

The annual charges against thermal storage are $3-220 00, but the annual saving in coal is, in this special case, 7,000 tons, besides the saving in ash removals and firing. Mr. Halpin thus obtains figures, giving an annual saving of $36,530.00 to pay interest on extra capital of $75,000.00, with coal about $5.00 per ton.

Now the only kind of storage against which Mr. Halpin has to compete, when high land is not available for utilizing water storage, is the storage battery; and from his figures, which seem fair to me, the extra capital required is $732,200.00, and the total annual extra cost, $110,750,00, which shows a great advantage in thermal storage.

I consider that all these figures are very conservative, and that in these days when we are learning to realize the importance of cutting down working expenses in central stations, this system must necesarily occupy an important place. But it is of peculiar interest to me, owing to its applicability to a kind of work to which I have devoted a large part of my time in the last seven or eight years. I refer to the burning of the house refuse and garbage in our cities. The furnaces in which this cremation is accomplished are geneally called "Destructors." It has been one of the great objects before me of late years to have this title abolished and to justify their being called "Utilizers." The improvements which we have introduced in the methods of burning refuse are so great that I can now undertake to produce the following results:

Taking the ordinary house refuse, ashes, coal, wood, paper, old books, vegetables, bones and scraps, crockery, tin cans, iron pots, bottles, and adding thereto occasionally dead cats and dogs, infected mattresses and condemned meat, I can throw the whole of these, without sorting into the furnace, and without producing any offensive odors or dust I can raise the temperature of the gases where they reach the boilers to over 2,000 F. From my data as to the amount collected in different houses in England per head of the population, I find that from the house refuse of any town I can supply steam enough to generate electric light at the rate of one 16 candle-power lamp per head of the population for two hours every night of the year. By doing this I am saving the municipality from $10,000 to $20,000 per annum per 100,000 inhabitants for the cost of the removal of house refuse. I am preventing these objectionable materials from being dumped into the outskirts of the city, where building operations will soon commence, or in the neighboring harbors or lakes, either of which plan is a nuisance and unhealthful. The only resulting material is a clinker, which can be broken up, and which when mixed with cement makes admirable concrete or artificial stone for paving, while by itself it makes excellent foundation for roads.

Now these enormous advantages, of the truth of which we have ample proof from a practice extending over nearly twenty years in England, can be worked at full economy only when the burning of refuse is quite continuous and uniform. To do this we must have storage of some kind. In hilly countries the plan I have advocated of water storage is generally available, and is very economical. In all other cases thermal storage is far and away the most economical mode of working, and in this line alone, if in no other, I have always said, from the first moment I knew of Mr. Halpin's invention, that we have here the last item which was wanting in order to do away with the barbarous methods generally adopted for getting rid of house refuse and at the same time utilizing that refuse in a manner that will confer material benefits on all the inhabitants of a great town, and pecuniary advantage on those who undertake the work.

DISCUSSION.

DR. BELL: In this country it seems to me that the plan of storing water power is one that can be worked successfully quite aside from the matter of thermal storage. For example, there are many places in the western part of the country, through the Rocky Mountain section and westward, where coal is to be had, to be sure, but it is altogether too dear for economical use. There is a little water to be had, but the supply is not steady enough for working the stations by water power direct. In such cases it seems as though the pumping of the available water into reservoirs might serve a very useful purpose.

PROF. FORBES: I have been asked for a comparison of the relative efficiency or cost of the system of the storage of water, which I had myself proposed, and that of thermal storage, which Mr. Halpin has proposed. The running expenses are almost the same in the two; but the economy of capital, if your reservoir is anywhere near your pumping station, is very much in favor of the water storage. The water storage takes off about 30 per cent. from the cost of a central station built upon the ordinary lines. That was so in the detailed plans which I worked out for the city of Edinburgh, Scotland. The thermal storage is rather more expensive to erect, but the annual saving on these two systems is about the same.

In the old fashioned method of building destructors it took ten pounds of refuse to produce the effect of one pound of good Welsh coal. Now we have reduced that quantity down to about five or six pounds of refuse to be equivalent to one pound of coal; therefore, it would take about thirty pounds of house refuse to equal five pounds of coal.

T. C. SMITH: A very common and familiar example of much the same process that Prof. Forbes has outlined can be seen in the boiler and engines commonly used for hoisting purposes. The same thing can be seen in nearly every elevator plant, where the boiler is much less in horse power capacity than the pump which it drives. The same thing can be seen to a very much greater extent in railway power stations, where in order to meet the demand upon the trolley, it is possible to exert a much greater horse power than is normally provided for by the equipment. The greatest doubt in my mind as to the success of this storage system is raised by the fact that identically the same thing was tried in the city of Boston, where a company was formed for the purpose of distributing power by hot water, called liquid steam, which simply meant water at a pressure and temperature corresponding to about 400 pounds, I believe. This water was carried through pipes, and when it was desired to use it in any building, the moment it escaped it became steam. The practical working of the plant was first rate. The thing collapsed, however, through an unexpected difficulty; and that was the tremendous and rapid destruction of the pipes from the continual use in them of the highly heated water.

How that would affect a plant of this kind where you could make it from steel, I do not know. The effect on the iron pipes, as used in the case cited, was to cause the abandonment of the system, and I understand the old material was sold recently.

MR. WIRT: The fireless steam locomotive is another example in point. We had these engines in service in Chicago for many years, during which they did good service, and were finally replaced by the cable line. These locomotives were of the ordinary type, but had larger steam boilers than usual. The boilers had no furnaces and were charged at one end with hot water under high pressure from an ordinary stationary steam boiler. The locomotive ran a round trip of six or eight miles, perhaps, and pulled very heavy cars and heavy loads, giving regular and satisfactory service, winter and summer. I would like to know why the storage battery fails in comparison with steam storage; whether it is depreciation, lack of efficiency, or interest charges. It is pretty evident that there is an advantage in working dynamos at full power twenty-four hours a day, as well as working the engines. It is also evident that if storage batteries are used, there is a saving on both engines and dynamos, which we do not get in the case of steam storage.

PROF. FORBES: I made a direct comparison between the cost of batteries and of the thermal storage system. The loss in connection with the storage battery includes all three of the items you named. Increased original expenditure in putting down storage batteries, which is far greater than the dynamos and machinery they replace, and also the great loss of efficiency—eighty per cent. being the efficiency at which they work, there being a loss of twenty per cent. of coal; and also the depreciation account, which I think every one must admit is about twelve per cent. per annum. I have installed numerous storage batteries, but have never done so in a central station. Storage batteries have their appropriate places, and I would like to see them

[1] [illegible] Electric Light association, [illegible]

much more used than at present in this country. There are a number of storage batteries that are available, and yet no one seems to work at them here. I have been told that it has been a question of patents; but this is hardly a reason, for some of the best batteries are founded on the Plante system, and that is open to the whole world.

MR. SMITH: We have once come to the conclusion that it would not pay to have storage batteries in a large building for the purpose of getting rid of night running. We have come to the conclusion that it will cost as much to get light from the battery, and that the same amount of coal will be burned for the reason that at once there is a loss of twenty per cent. of energy in the battery. It will be necessary to employ practically the same force to look after the storage batteries as to run the engines, and we have failed to see that there will be any economy in it.

PROF. FORBES: As to the attendance required in the care of storage batteries, that thing has been minimized on the other side. We find that we can instruct a person of ordinary intelligence in the care of the batteries in a few hours, and often this duty will fall to the carpenter, or gardener, or even butler, on some of the large estates. Even in the larger plants, we do not think it necessary to have any one in constant service; but we have instituted a system of daily and weekly inspection of the apparatus to see that everything works efficiently, and to supply defective parts, and on the whole we meet with much success.

DR. BELL: I think one reason why the storage battery has been such a failure on this side of the Atlantic is because it has been exploited from the time it first made its appearance here for the purpose of street car traction or other purposes to which it is least adapted, on account of the racking of the batteries in going over rough tracks, and also on account of the frightful variations of the load, which destroy the efficiency of the battery and cause "buckling" and rapid deterioration of the plates. It has been tried with a pertinacity worthy of a better cause; but the net result has been failure in this respect. It is a fact that we have put the storage battery to the hardest service that could be imagined, and that has caused the storage battery to fall into disrepute here. If it had been started in the places in which it belongs, isolated plants, such as Prof. Forbes referred to, it would have gotten far greater headway in this country, and it is possible that some of the experiments in using it for traction would not have been such lamentable failures.

MR. HAMMER: I think another reason is that in England, France and Germany they use accumulators about the size of a trunk. Probably the small depreciation and commercial character of these accumulators is to a considerable extent due to the massiveness and the mechanical strength of the plates, and the cases in which the accumulator plates are placed.

MR. FORBES: I do not, however, think it is true that the size of the cells enhances materially their efficiency, or the number of plates that they contain. The smaller cells, as long as they are large enough to be made in a solid, mechanical manner, last just as well, and their efficiency is relatively just as high as the large ones.

Some Experiences with the Alternating System.[1]

BY R. H. STERLING.

To those who adopted the alternating system in the early days I need not recall the feelings with which we looked on this long distance transmission of energy for incandescent lighting. It was such a gigantic stride—such a radical departure from previous methods of incandescent lighting—that many who had experimented for the benefit of parent companies before were a little cautious about nursing this new infant up to the state of practical manhood. Especially were we so when so much was said and written by the opposition and by others who claimed to be non-partisan. However, our company, among the first, did install a large alternating plant—the largest, I believe, at the time in the United States. How wise we were in doing so I will answer by pointing to the enormous growth and success from the start of alternating current lighting, and its finally being fostered by those who were at first its bitterest enemies.

We did experiment some, I will admit. A few minor details in apparatus did not just meet the requirements for practical use; but our parent company has always been willing to adopt the suggestions of its users and remedy defects discovered by them—a plan by the way, which should be followed by all who manufacture apparatus—for the central station men are those who are best able to judge its merits and criticise it from all sides.

I will now take the principal features of an alternating station in detail, describing what have been our results and the best practice in my experience.

I will begin with the switch-board—a subject often discussed in these meetings, but none the less important—and I will try as much as possible not to go over the same beaten track, with possibly some new details. A circuit board is eminently better made of marble, as a matter of both safety, durability and appearance, and should have plenty of space between it and the wall. The dynamo bus wires should run in horizontal rows on the back with plug holes extending through to the front to connect to either side of each changing switch. There is a changing switch, of course, for each feeder or circuit, and all bus wires can be connected to any particular feeder. The front of the board should be divided into perpendicular panels, each panel representing a feeder.

On the back there will be the converter for voltmeter, compensating devices, etc., and the fuse blocks. These are preferably placed on the back, as it is an unpleasant thing to have a fuse blow in a man's face, and they should not be so high on the board that they cannot be reached standing on the floor. Many of you, undoubtedly, have had trouble with a fuse arcing, and finally melting the fuse block into a conglomerate mass, or setting fire to the switch-board. There are two simple remedies for overcoming this; one is to have all fuses covered with a piece of asbestos paper rolled around the fuse wire or link in the form of a tube, a little larger on the inside diameter than the wire, to allow for radiation of heat, so that the fuse will not melt under its rated capacity. These asbestos tubes are very easily made, and can be pasted either with shellac or silicate of soda, which is preferable, the idea being that when the fuse is blown, the pent-up gases in the tube are forced out at either end so violently that the resulting arc is dissipated immediately. I believe I am not the originator of this idea, but believe we can claim the use of asbestos as our own, and which is the only substance that is practicable.

Another simple plan to prevent arcing is to have all fuse blocks placed on a narrow shelf, with their faces up, as there is always a tendency in an arc to take an upward direction, owing to the current of heated air resulting from it, and in taking this direction there is a natural pulling away of the arc from the two metallic portions of the fuse block; whereas, were it in a perpendicular position with the current usually coming in at the bottom of the block, this upward tendency of the arc only completes the path across the gap, and so continues arcing. Fuse wire as now made is quite reliable as to its carrying capacity, but like many other good things, is not trustworthy, if abused. A lead fuse, either wire or flat link, should never be screwed down under a screw head and washer, no matter how small the carrying capacity it is intended for. This may do for a short time, but the soft metal soon loosens up, a poor contact is formed and the fuse melts from the heat thus generated, causing no end of annoyance. This applies to fuses, no matter where they are used, all over the circuit. The one way out of this is a small flat copper terminal, slotted to slide under the screw head, and soldered to each end of the fuse wire. The carrying capacity of the wire can be stamped on one terminal. These are cheaply made. A boy with a punch and die can stamp out many hundreds of them in a day, and the soldering, with a little experience, is rapidly accomplished. Had we adopted these fuses when we first began to furnish light, five years ago, and insisted on all inside wiring being fused in this manner, we should have been many dollars ahead to-day, and there would have been fewer lights out during that time.

Nine-tenths of the calls on our complaint book show a record of fuses blown in branch or main blocks of inside wiring, which we have to send men out to replace, and from repeated inquiries from these men I find that this same proportion of nine-tenths would hold good for fuses that had blown or rather melted from poor contact, due to lead becoming loose under screw heads, and from no cause of short-circuits, overloading or trouble in the wiring. We now compel all wiring contractors to use a copper terminal fuse, and we ourselves replace all blown-out fuses with this style; but with seventy-five thousand lights connected up, we do not see our way clear to weeding out the old fuses just at present; so let this be a warning to those young in the business.

On the front of the switch-board we have for each section or panel a volt and ampere meter for every feeder, one over the other, and surmounting these a pilot lamp run from the converter supplying the voltmeter, whose primary should be tapped on the feeder wires above the fuse block, so that should a fuse go out quietly, as is generally the case when fuses are arranged in the manner I have mentioned, the attendant's attention will be called to the fact by the extinguishing of the pilot lamp. The changing switch, generally placed on the front of the board for each feeder, should be about breast high, so as to be easily reached to make a quick throw. I say usually placed on the front of the board, as it is only recently that a new switch has come out that has its jaws and contacts so arranged that it can be placed in the rear of the panel, with the lever extending through a slot to the front of the board. This is a matter of great safety to the switch tender, for, as stations increase in size and load, a new element of danger sometimes manifests itself in the act of throwing these changing switches. A violent arc is formed which follows across from one set of contacts to the other, throwing two dynamos in multiple through the medium of this arc burning the attendant's face and hands, and sometimes wrecking an armature, as, of course, the two dynamos are not apt to be in synchronism when thus thrown together. Placing the switches horizontally will lessen greatly the continuance of this arc, on the same principle that I have mentioned the placing of fuse blocks on the switch-board with their faces up, and a fibre or slate partition between the jaws will prevent the arc short-circuiting the dynamo. This annoyance is only met with on feeders of considerable length and those having a large number of converters on them. It is due to inductive discharge from converters and line, and is similar to the extra current at field discharges of a dynamo. Its occurrence depends largely upon the period in the wave phase at which the circuit is opened, and is proportional to the length of the circuit and the number of converters connected on the line. I have found this discharge to occur more frequently on circuits whose converters were partially loaded. This would naturally seem to be the result when the secondary coils of the converters were exerting no action on the primary, but I have had the most severe arcing on circuits with heavy loads. The damaging result of these arcs, however, has been entirely diminished since placing the switches [illegible], I have placed only of the feeder ammeters. There should, of course, be an ampere meter for each dynamo. These are preferably placed together in a group at one end of the board, so that at a glance the attendant can see what load he is carrying on or on what dynamo there remains room for more feeders as the load comes on or goes off. The regulators and rheostats can be placed at the base of the switch-board, or, much better, if there is room, in a compact row out in front of the board about four feet, on a strong framing of wood or iron, so that all the voltmeters can be watched at the same time that the adjusting of the pressure is taking place. This saves the annoyance of the attendant jumping from the rheostat out to the front to catch a glimpse of the voltmeters to see how near he has come to guessing at the right amount of resistance he should have thrown in or out. The result will be far better service if the rheostats are thus arranged.

This now brings us up to the remaining feature of the switch-board—the lightning arrester—although I can not say that, necessary as this last-named appliance is, the switch-board is the all-important place for it. There may, however, be a lightning arrester on each side of every feeder, placed in a row on the top of the board or on the wall back of it, and heavy copper wire running along past this row and connected to each arrester with a tap wire, and the main wire leading to a good ground in as straight a path and with as few crooks and turns as possible, as every bend offers a source of self-induction detrimental to the flow of the lightning discharge. The source of ground cannot be too perfect; have several of them radiating off to different points, to a mass of metal in a well or soldered to a water main, so, should one fail, the other may be relied upon. The lightning arrester itself should be an instrument devoid of fuses, be capable of rupturing instantly the arc formed, and still remain set for a second discharge; should be free from all moving parts; not absorb energy, and should be so reliable and substantial that it could be set up anywhere on the line and forgotten, and still perform its duty. This may seem to you like an ideal instrument, but, so far as alternating currents are concerned, I am positive that this state of perfection has been attained in a certain arrester now on the market. There is no question about the efficacy of lightning arresters placed out on the line if we wish to keep the lightning out of the station and protect our converters, especially in districts remote from other wires and tall buildings, as in the residence portion of cities. It is a good plan to place one at each end of the feeder and branch main, and scattered at intervals midway on the circuit; they also are a wise protection over a large bank of transformers, notwithstanding the fact that we are taught to believe that lightning abhors an inductive resistance as nature does a vacuum, and that a collection of such resistance would be self-protection, yet it does not prevent the discharge entering the case of the converter; then it does not have to jump much more than the space of one-eighth of an inch over to the plates to ignore these inductive coils, reach the secondary outlets, and thence to the house wiring, when it generally finds an easy path to earth with the close proximity of inside wires to gas and water pipes, and especially on combination fixtures with poor insulating joints. This does not always completely burn out the converter, as oftentimes this discharge has only ruptured the primary coils on the first turn of the wire at the point where it has jumped to the frame holding the plates, and is easily repaired. I imagine this is the case when a discharge takes place when there is no dynamo current on the lines; at other times there is a complete destruction of both coils. In a great many instances we have traced converters burned out by lightning to defective insulation in the house wiring. Whether the ground actually existed before the disruptive discharge, or was caused by it, we could not always tell. I did find one place where the wire was fused to a gas pipe up in the attic, the discharge evidently having jumped through the insulation, as the wire had been carelessly left resting on the pipe. Of course, the primary fuse, having blown in the burning out of the converter, did not leave the circuit permanently grounded. We do not want the house wiring a safety valve to relieve the circuits of their static charges; and therefore have lightning arresters, plenty of them, that will offer an easier path to earth across small arcing gaps, smaller than can be found in the converters; but no matter how perfect the arrester is it is valueless unless it has a good ground connection and a straight copper wire, not smaller than No. 6, without bends or turns, connecting the two. A very convenient method I have found to make a reliable earth connection for arresters out on the lines is to dig a hole at the foot of the pole about two feet in diameter, three feet deep, and driving down through it a twelve foot length of 1¼ inch galvanized iron pipe, having on the lower end a driven well point to allow it to be driven easily, and a cap screwed on the top to prevent the sledge-hammer splitting the pipe. The No. 6 wire can be more thoroughly soldered to the pipe before it is sunk. The upper end should be driven to about one foot below the surface, and the hole filled in with finely broken coke, which increases the conducting surface at that part of the earth that is the driest, and the lower end of a twelve-foot pipe will usually be in moist earth, and can be relied on to furnish a good connection at all times. I once had an electric light man tell me that he considered a small coil of wire buried just under the surface of the earth sufficient grounding, as the rain would immediately soak the earth and make all the ground he wanted. I have observed severe lightning discharges that took place before a drop of rain had fallen.

While on the subject of the burning out of converters, I will mention an annoyance we sometimes meet with in a primary fuse blowing, arcing and welding the

1. Read before the National Electric Light association at St. Louis, Mo., February 28, 1893.

leading-in wires to the case, or so carbonizing the fuse box that a short-circuit is formed on the line. This will always be the case where a fuse carrying a high potential current blows in a pent up space, with no chance for the gases to escape. The arc is being fed, and increases until a fuse is blown at the station and shuts off the supply of current. Generally, on throwing in this feeder again, after replacing the station fuse, it will be found to work all right if the wires are not fused to the converter case, or everything is not carbonized inside. We have in some instances, on its again blowing the station fuse, fused up a little heavier and finally removed the trouble, not fusing to that extent that it would wreck the armature. We are learning now that it is far preferable to have no primary fuses in the converter case, but a large primary fuse and switch blocks combined, removed from the converter to protect it. We have long since discarded secondary fuses in converters, replacing them with copper wire; and let me remark here that this is what a member of this association meant when he made the statement before one of its conventions that we had been substituting copper wire for all our primary fuses; he evidently mistook the primary for the secondary end of a converter. This would also be a sad mistake to make when fooling with hornets.

This short-circuiting of the line by the burning out of converter fuses and other causes led me to adopt a combined switch and fuse box on all branch lines leading from the main feeders, and we have found them of immense benefit.

The switch cuts off all connection from the line wires in fusing up, and also makes a convenient means of disconnecting that part of the circuit to locate grounds and other trouble. Then the greatest usefulness is their blowing when there is a short-circuit on the branch they protect, thus preventing every light on the rest of the circuit going out by the station fuse blowing. Then, again, it locates at once where the trouble lies by sifting it down to one of, say, twenty branch mains, by telephone calls pouring in that lights are out at such a place.

As alternating stations increase in size and larger units of dynamos are adopted—which is certainly a wise step toward economy—another class of appliances is required at the switchboard, namely devices for independently regulating the state of pressure on any particular feeder, the dynamo pressure remaining the same. The necessity of this can readily be seen, for we will have, say, on the same dynamo, when it is of large capacity, several feeders of different loads; those carrying the greatest number of amperes requiring a higher electromotive force to overcome the drop on line, so that if this required pressure all came from one source, these feeders of lighter load would be receiving too much potential, and a large lamp breakage would be the result. Therefore, the potential of the dynamo is regulated for the lighter feeders, and pressure raisers or "boosters" used to bring up the potential still higher for the remaining feeders. The principle of these regulators is this: if we take a converter whose capacity equals the maximum load of the circuit and connect the secondary in series with one side of the feeder, and the primary across the two sides, we are then adding the fifty volts of the secondary of the converter to the 1,000 volts of the line, raising its initial pressure five per cent. Adding a number of these in series in like manner, and having a suitable switch to throw them in or out in succession, makes a very convenient means of raising voltage, but resembles somewhat, as I once heard it remarked, a man raising himself up by his boot straps. I have sometimes found it very useful connecting in ordinary converters at the switchboard, for temporary heavy loads, in this manner, where feeders were not provided with the regular "boosters."

Reactive or choking coils may be employed instead of "boosters," with the same end in view, that is, the proper adjustment of pressure on feeders of unequal drop supplied from one source—only in their use they will be placed on the lighter feeders and the dynamo be made to raise the electromotive force for those having the heavier load. The first cost, I think, would be in favor of the reactive coils, but the relative economy in energy consumed would be slightly in favor of the pressure raisers.

A serious annoyance is often met with on the line from the inductive effect of two parallel circuits upon each other, causing the lights to waver, or "pump," which better expresses it. When this trouble first manifests itself in a station, the engine is generally the first thing to be blamed, and the engineer is caused many sleepless nights or days in trying to remedy it.

We seldom find this effect in small stations, unless the feeders are parallel to each other for a considerable distance. It is most marked in circuits that are parallel and one of them carrying a heavy load, which exerts this inductive influence on neighboring lines on the same principle as the primary coil of a converter inducing currents in the secondary parallel to it; only in the case of this action on the lines, where each line is fed from a separate dynamo, their phases, of course not corresponding, we have in this cross-induction a very unsteady action in the current. Annoying as this trouble is, it is one of the easiest to remedy. First, see if some combination on the switch-board will not bring about a change in affairs. Ascertain if the several lines on which the trouble is noticed cannot all be run on the same dynamo, but if this should cause this induction to appear on other circuits formerly free from it, the [illegible] to transpose the circuits midway between the starting point and where they cease to run parallel [illegible] a break arm in each side of the line and [illegible] the shape of a cross the four ends thus formed. This will neutralize and break up the trouble completely.

The topics I have touched on in my paper have been chosen as those most interesting and worthy of discussion, and with the hope that they will be of benefit to some of you, and call to mind other experiences I have not mentioned, which if givan freely before a body of this nature, will help to bring about the results which we are all striving for—good service and dividends.

Discussion.

Mr. Wagner: The Stillwell regulator is a converter arrangement, used to raise the potential at will on any circuit or feeder, by means of series contacts usually differing about one per cent. The regulator, as usually constructed, may be used to raise the potential on any feeder from one to twenty per cent. It is a simple converter, with ordinary coil, connected in the usual way in multiple with the circuit or shunt to the secondary coil, which is adjustable in length, or has a number of ends brought out, placed in series with one leg or one side of the feeder, and adding its potential to that of the line or the dynamo.

A. J. DeCamp: A company in which I am interested has just started into furnishing incandescent lights, using the alternating system, running two machines, one of 1,300 and the other of 1,000. This company has recently bought another machine of 2,000 lights. I would like to know what is the relative value of the alternating system, within a prescribed circuit, say, of one or two miles, as compared with the direct system, with the machines coupled in multiple?

Mr. Wagner: In regard to the flexibility of the alternating system, and the possibility of using the station units to their utmost capacity, I have never in my practice found it necessary to run any station unit under seventy-five or eighty per cent. of its total capacity. By a simple switch-board arrangement it is possible to connect as many circuits to one dynamo as is desirable, and as the load falls off the station the units or dynamos are shut down and the feeders are gradually brought together on a few dynamos, and in that way the station apparatus can be used as economically and advantageously as with direct current. We couple the circuits together instead of coupling the machines together, and that can be done without interrupting the service for even a moment on any circuit. It has now become possible to run arc lamps as well as motors on the alternating circuits, and I think that it has at last become almost universally conceded that for most purposes the alternating current is as flexible as the direct current. In this city we cover an area extending six or seven miles from our station in several directions. The station is situated almost at the center of the district, and in that district we have between seventy-five and eighty thousand lights; and we have never had any trouble from want of flexibility of our machines or circuits.

Capt. Brophy: Where there are four or five circuits, no two of which are of the same size or less, you cannot couple them together and do satisfactory work. You will find in many of the smaller stations, and in many of the larger ones, too, a difference in circuits, a difference of drop anywhere from five to fifteen per cent. This is one cause of trouble that a great many companies do not seem to understand.

Mr. Wagner: This suggestion again brings up the subject of the "booster." It is just as possible with alternating circuits as with direct circuits to use feeder regulators. The feeder regulators ordinarily used simply throw resistance in the circuits; and if there is one circuit which is run from one dynamo, or a number of dynamos connected in multiple, which has a ten per cent. drop, all other circuits connected with it must have resistance thrown in to bring them down to the same pressure as the one feeder with the ten per cent. drop. That is done with feeder regulators, or by throwing resistance, or by cutting out feeders. In a properly constructed alternating system it is just as necessary to use a system of feeders and mains as with the direct system. Generally the same devices can be used for regulating either current, but the Stillwell regulator is a device which can only be used on alternating circuits, and is much more economical to use than any other form of feeder regulator, using resistance, as this regulator raises the potential of any one circuit instead of lowering it. The circuits with small amount of drop are left as they are, and those with greater load are raised sufficiently to bring the potential at the end of the feeder to the proper standard. I believe it is usually customary in direct current systems to connect all the feeders and mains together, forming a complete and continuous network. It is claimed as an advantage for the purpose of keeping a uniform pressure throughout the system. It occurs to me that it has a distinct disadvantage in case of ground or trouble occurring on the line. It then becomes very difficult to locate it. In the alternating system it is usual to keep each feeder and its system of mains entirely separate outside of the station, simply throwing them together in the station. Any short circuit or ground or burn out, any trouble occurring on one of the circuits is immediately indicated by the station instruments or fuses, and is located and confined to quite a small district. It can very much more quickly be repaired than if all the feeders were connected together, and a great number of miles of wire had to be inspected in order to find the trouble.

Prof. E. Weston: The question of the distribution of energy by the two systems under discussion is receiving great attention both on this side and the other side of the Atlantic. At the present moment I do not think any one is in a position to fully answer the question which is the more economical of the two systems. As established here they differ radically in one respect at least from the systems established on the other side. Here, for the purpose of economy in the first cost, a very high rate of alternation has been adopted. From experience it seems as though this was a fundamental mistake, and that the mistake will be more apparent as the wires are forced underground, sooner or later. We must all recognize the fact that any system of aerial conductors can never give us the safe and sure service to compete with a satisfactory and reliable source of illumination such as gas. If the alternating current systems of this country were forced under ground undoubtedly the loss would be greatly increased; but exactly what the loss is at present, I have not been able to find out. With the direct system the losses are at the lowest point, and are very small indeed, when the load is very light. The energy consumed then is practically what is used in the lamps; but in the alternating system there is an increase of loss in the converters. I think that the alternating system as it exists in this country to-day will be radically modified in the next few years so as to approach more closely the systems of Europe, and I think that the tendency will be toward a lower rate of alternation and greater general efficiency.

Mr. Blaxter: I would like to ask Mr. Weston if he thinks that in going underground with the alternating system the loss would be greater with the high number of alternations than with the overhead system?

Mr. Weston: I should expect the loss to be greater on account of the inductive influences.

Mr. Blaxter: Would not the concentric system of wiring obviate a good deal of that trouble? Would it not reduce it to such an extent that it would not be any more than with the overhead system?

Prof. Weston: The concentric system is being tried on the other side, and they have met with serious difficulties. I think it will be found that there is a greater loss underground.

Mr. Hammer: There is one point in connection with the comparison between the two currents which has been an interesting one to me. I refer to the relative life of the incandescent lamp on continuous and alternating currents. I remember one of the oldest engineers in Europe quite a number of years ago published a statement shortly after the introduction of incandescent lighting, that the lamp would last longer with the alternating than with the continuous current; but within a brief period another statement was published that the opposite was the case. It is a well known fact, however, that an incandescent lamp will last longer at a lower rate than at a higher rate of alternation. What is the relative life of a set of lamps working upon an alternating circuit, compared with a set working on the direct circuit, under the same conditions, or as nearly as possible under the same conditions?

Charles Wirt: Regarding the difference in the life of lamps on the alternating and direct current, I think that question has almost been settled by laboratory tests and the result of large experience. It has not been claimed for some time now, to my knowledge, that either system is far superior to the other as regards the lamp life. A recent report on this subject was made in Europe, and it summed up the matter something like this: It seems to us that these results would dispose of the question of the continuity of the life of the lamp on the alternating as compared with the direct current; the results having shown that there is practically no difference between the two.

Dr E. C. Kilbourne: The question as to the relative value of the two systems depends largely on the field you are going to operate in. In Seattle we have both systems, and find they do not conflict; and we also find the alternating system just as flexible, and in some respects more flexible than the direct system.

Electric Circuit of St. Louis.

At a meeting held on Feb uary 21st at the station of the Missouri Electric Light & Power company of St. Louis an electrical association of the younger men in the business in that city was formed. The officers and members are: F. D. Beardslee, president; H. H. Beardslee, treasurer; Gus Sack, vice-president; Anson Murphy, sergeant-at-arms; W. S. Merkle, secretary; members, J. H. Fenton, A. R. Verdier, A. R. Pike, Geo. Bahret, Chas. K. Cooke, J. H. Burke, H. H. Beardslee, Gus. Sack, J. B. Price, F. D. Beardslee, W. F. Warrance, John Dillon, Anson Murphy, John P. Lynch, E C. Kiecker, J. H. Cooke, E. W. Cooke, T. S. Clark, W. S. Merkle, Gus. Krening, A. W. Mitchell, L. Mathew. The name of the club is "The Electric Circuit of St. Louis." A permanent place of meeting will soon be chosen.

The Lancaster, Pa., & Terre Hill Street Railway company has been organized to build a line to take in four outlying towns.

The Chesapeake & Washington Underground Electric Railway company will, if its bill is passed, build from Washington through southern Maryland to a sea bathing resort on the Chesapeake beach. The Robertson insulated conduit electric system will be used.

Under the title of the Verband der Elecktrotechniker Deutschlands, an association has just been constituted in Berlin. The members comprise the leading electrical firms, many scientific notabilities, and representatives of all the electro-technical societies now scattered throughout Germany. The scope of the union is very varied, as in addition to being an electrical institution it will watch over the interests of the industry, and give reliable information concerning the views of electrical engineers. An instance quoted as showing the necessity of such an institution was the case of the recent telegraph act, and it is now intended that the union shall be of use in connection with the forthcoming legislation on electric light and power industries. All those either directly or indirectly interested in the different branches of electrical applications, and particularly industrial customers and municipal and other administrations, will be invited to join the union, which is to hold its first annual assembly in August or September next.

Members and Visitors.

Following is a carefully prepared list of the members and visitors in attendance:

Ackerman, P. C.....New York, N. Y.
Adams, A D.....Indianapolis. Ind.
Adams, H. C.....New York, N. Y.
Adams, Dr. Wellington.....St. Louis, Mo.
Ambler, T. N.....St. Louis. Mo.
Armstrong, E. A.....Camden, N. J.
Armstrong, Miss Elizabeth W.....Camden, N. J.
Asbton, W. H.....Dayton, O.
Atkinson, E. P.....New York, N. Y.
Austin, W. B., and wife.....Rensselaer, Ind.
Ayer, James I.....St. Louis, Mo.
Ayers, M. P.....Jacksonville, Ill.

Babcock, C. A.....Cuyahoga Falls, O.
Babcock, E. I.....Cuyahoga Falls, O.
Bailey Geo. C.....Chicago, Ill.
Bailey, Wm. J.....Chanute, Kan.
Baird, M. E.....Windsor, Conn.
Baker, C. O., Jr.....New York, N. Y.
Ball, W. D.....Chicago, Ill.
Barnes, C. R.....Rochester, N. Y.
Barth, J. D.....DeSoto, Mo.
Bauer, A. H.....Chicago, Ill
Beal, M. A.....Rockford, Ill.
Bean, W. Worth.....St. Joseph, Mich.
Beetle, Geo. L.....Chicago, Ill.
Bell, Dr. Louis.....Boston, Mass.
Berkey, John A.....St. Paul, Minn.
Bernard, E. G.....Troy, N. Y.
Bibber, Charles E.....Boston, Mass.
Bishop, R. S.....Lockport, N. Y.
Blaxter, G. H.....Pittsburg, Pa.
Boardman, T. S.....Kenosha, Wis.
Booker, S. G.....St. Louis, Mo.
Bradley, Chas. S.....Rochester, N. Y.
Bragg, C. A.....Philadelphia, Pa.
Bragg, J. B.....Kirksville, Mo.
Brooks, H. H.....Boston, Mass.
Brophy, William.....Boston, Mass.
Brown, C. E.....Chicago, Ill.
Bryan, W. H.....St. Louis Mo.
Bryant, W. C.....Bridgeport, Conn.
Bulkley, M. J.....Chicago. Ill.
Burleigh, John J., wife and daughter.....Camden, N. Y.
Burns, P. C.....St. Louis, Mo.
Buss, E. W.....Chicago, Ill.
Butler, C. J.....Jonesboro, Ind.

Cable, Paul D.....Chicago, Ill.
Campbell, S. S.....Denver, Colo.
Carnes, W. W.....Memphis, Tenn.
Carpenter, C. E.....Bridgeport, Conn.
Cassier, Louis, and wife.....New York, N. Y.
Churchill, F. A., Jr.....St. Louis, Mo.
Claflin, G. E.....Kansas City, Mo.
Clark, D. M.....Vandalia, Ill.
Clark, Anna M.....Vandalia, Ill.
Clark, Ernest L.....Chicago, Ill.
Cleveland, W. B.....Cleveland, O.
Clohessey, Thos F.....Kansas City, Mo.
Clisdell, P. A.....Cincinnati, O.
Clower, D. M.....Dallas, Tex.
Coffman, John R.....Chicago, Ill.
Colby, J. A.....Des Moines, Ia.
Coleman, S. G.....Milwaukee, Wis.
Collins, L. W.....Chicago, Ill.
Collins, W. F.....Chicago, Ill.
Colvin, F. R.....New York, N. Y.
Conover, A. B.....Chicago, Ill.
Connor, J. F.....Chicago, Ill.
Corey, R. B.....New York, N. Y.
Corriveau, Albert J.....Montreal, Canada.
Cowgill, M. J.....Omaha, Neb.
Craig, H. C.....Stevens Point, Wis.
Crane, J. O.....Waterbury, Conn.
Crider, J. S.....Pittsburg, Pa.
Cross, A. A.....West Superior, Wis.
Crossman, T. E.....Brooklyn, N. Y.
Culver, Frank S.....Eau Claire, Wis.
Cuming, Miss.....Philadelphia, Pa.
Cummings, E. A.....Chicago, Ill.
Cutter, Geo.....Chicago, Ill.
Cutter, H. B.....Philadelphia, Pa.

Davis, D. L.....Salem, O.
DeCamp, A. J., wife and daughter.....Philadelphia, Pa
Dee, J. R.....Houghton, Mich.
Degenhardt, F. E.....Chicago, Ill.
DeLand, Fred.....Chicago, Ill.
Dickerson, J. W.....Chicago, Ill.
Doan, T. M.....Jacksonville, Ill.
Douglas, S. A.....Chicago, Ill.
Drake, F. E.....Chicago, Ill.
Dutton, A. W.....St. Louis, Mo.
Dyer, L. F.....St. Joseph, Mo.

Edgar, George B.....Cincinnati, O.
Elliott, H., Jr.....St. Louis, Mo.

Fairbanks, H. H.....Worcester, Mass.
Ferguson, James.....Brooklyn, N. Y.
Ferguson, J. A.....St. Louis, Mo.
Flower, W. L.....St. Louis, Mo.
Foote, J. B.....Battle Creek, Mich.
Foote, W. A.....Jackson, Mich.
Forbes, Prof. Geo.....London, Eng.
Fortner, Miss Annie E.....Chicago, Ill.
Foust, Charles J.....Cincinnati, O.
Francisco, M. J., and wife.....Rutland, Vt.
Freund, H. W.....Vincennes, Ind.

Gamp, Leo H.....Kansas City, Mo.
Gerleman, J. F.....St. Louis, Mo.
Getz, R. J.....Buffalo, N. Y.
Godfrey, J. W.....New York, N. Y.
Goe, D. E.....Chicago, Ill.
Goldsmith, E. W.....Chicago, Ill.
Goodhue, Wells.....Chicago, Ill.
Gorke, H. J.....Syracuse, N. Y.
Grant, C. W., and wife.....Davenport, Ia.
Greene, E. B.....Altoona, Pa.
Greene, W. J.....Cedar Rapids, Ia.
Greene, Mrs. Moshier T.....Chicago, Ill.
Greene, B. E.....New York, N. Y.
Gregory, C. E.....Chicago, Ill.
Grier, Thomas G.....Chicago, Ill.
Gwynne, J. G.....Steubenville, O.

Hadaway, H. I.....Chicago, Ill.
Haines, H. M.....New York, N. Y.
Haley, C. S.....Boston. Mass.
Hall, E. J., Jr.....New York, N. Y.
Hall, A. Mitchell.....New York, N. Y.
Hammer, W. J.....New York, N. Y.
Harding, H. H.....Carthage, Mo.
Harvey, A. W.....Chicago, Ill.
Hatch, E. B.....New York, N. Y.
Hatch, E. B.....Hartford, Conn.
Hawkes Vivian.....London, Eng.
Hayden, M. W.....New York, N. Y.
Heinrich, E. H.....Pittsburg, Pa.
Heinrich, R. O.....Newark, N. J.
Higbee, E. H., Jr.....Roodhouse. Ill.
Hills, Charles I.....Boston, Mass.
Hinchliff, Wm. E.....Rockford, Ill.
Hioe, Henry.....Pittsfield, Mass
Hodge, Wm C.....Buffalo N. Y.
Hoover, John.....Pittsfield, Mass.
Hoover, P. H.....Chicago, Ill.
Hopkins, J. H.....St. Louis, Mo.
Horr, J.....Peru, Ind.
Horry, W. S.....Philadelphia, Pa.
Howell, Wilson S.....Newark, N. J.
Hunter, D., Jr.....Allegheny, Pa.

Issertel, Henry G.....New York, N. Y.

Jackson, Geo. J.....Norwich, Conn.
Jackson, George J.....New York, N. Y.
Jenney, C. D.....Indianapolis, Ind.
Jones, C. E.....Cincinnati, O.
Jones, A. J.....New Brunswick, N. J.
Johnson, Thos.....Seubenville, O.
Johnston W. J.....New York, N. Y.

Kearney, James M.....Chicago, Ill.
Kester, J. F.....Chicago, Ill.
Key, W. S.....Boston, Mass.
Kilbourne, Dr. E. C.....Seattle, Wash.
Knight, J. C.....New York, N. Y.
Knight, C. S.....Fort Wayne, Ind.
Knight, W. C.....Fort Wayne, Ind.
Korst, P. H.....Racine, Wis.
Koh'er, Frank.....Chicago, Ill.
Kohler, George A.....Chicago, Ill.

Lane, F. A.....Cleveland O.
Larkin, Edwin L.....Galesburg, Ill.
Laurence, A. B.....New York, N. Y.
LeVake L. B.....Cleveland, O.
Lipscomb, M. L.....Columbia, Mo.
Little, E. W.....New York, N. Y.
Little, E. E.....Pittsburg, Pa.
Little, F. P.....Buffalo, N. Y.

Mace, Romaine.....New York, N. Y.
MacKie, Robb.....Cincinnati, O.
Magee, F. A.....New York, N. Y.
Manson, George T., and wife.....New York, N. Y.
Manning, H. S.....Chicago, Ill.
Manwaring, A. H. and wife.....Philadelphia, Pa.
Markland, W. H.....Altoona, Pa.
Martin, T. C.....New York, N. Y.
Martin, A. J.....Philadelphia, Pa.
Martin, John K.....Philadelphia, Pa.
Marsh, J. W.....Pittsburg, Pa.
Mason, Frank C.....Brooklyn, N. Y.
Mason, J. H.....Boston, Mass.
Matthews, W. N.....St. Louis, Mo.
Mayo, Geo.....Rockford, Ill.
McCullough, W. E.....Beardstown, Ill.
McDuffie, H. S.....Pittsburg, Pa.
McFall, C. H.....New Orleans, La.
McFarland, G. E.....Davenport, Ia.
McGonnigle, R. G.....Pittsburg, Pa.
McIntire, C.....Newark, N. J.
McKinlock, W. C.....Chicago, Ill.
McKinlock, W. H.....Chicago, Ill.
McMaster, Frank.....Chicago, Ill.
McRae, A. L.....Rolla, Mo.
McQuaide, J. P.....New York, N. Y.
Mead, C. K., and wife.....Des Moines, Ia.
Merrit, Matt M.....Boston, Mass.
Miller, J. D.....New York, N. Y.
Miller, A. M.....Kansas City, Mo.
Miller, J. H.....Springfield, O.
Mitchell, P. W.....New York, N. Y.
Moore, John J.....Toledo, O.
Moore, F.....Pittsburg, Pa.
Moore, John J.....New York, N. Y.
Morgan, Miss Carrie W.....Camden, N. J.
Morrison, W. J.....Syracuse, N. Y.
Morse, S. F. B.....Chicago, Ill.
Mosher, J. A.....Chicago, Ill.
Myers, Gen. M. and wife.....Kansas City Mo.
Myers, H. C.....New York, N. Y.

Nahm, Louis.....St. Louis, Mo.
Newton, A. D.....Windsor, Conn.
Newton, C. E.....Hartford, Conn.
Nichols, Frederic.....Toronto, Ont.
Nipher, Prof F. E.....St. Louis, Mo.
Noll, August.....[illegible]
Norcross, P., and wife.....[illegible]
Nunn, P. N.....[illegible]
Ogden, D. H., and wife.....[illegible]
O'Hara, J. E.....[illegible]
Osborn, W. T.....[illegible]
Osborne, W. F.....[illegible]
Oswold, Wm.....[illegible]

Packard, W. D.....Warren, O
Page, Chas. T.....Chicago, Ill.
Paiste, H. T.....Philadelphia, Pa
Pardee, E. T.....Syracuse, N. Y.
Parker, J. H.....St. Joseph, Mo
Partridge, A.....St. Louis, Mo.
Pearson, F. J.....Omaha, Neb.
Peck, E. F.....Brooklyn, N. Y
Penn, Jerome.....Washington Court House, O.
Pentz, James A.....Philadelphia, Pa.
Perry, Nelson W.....New York, N. Y.
Perry, D. P.....Chicago, Ill.
Perry, F. L.....Chicago, Ill.
Porter, Geo. F.....New York, N. Y.
Postoo, M.....Nelsonville, O.
Powers, E. L.....Chicago, Ill.
Price, C. W.....New York, N. Y.
Pyle, George C.....Indianapolis, Ind.

Quine, Mrs. J. N.....Rochester, N. Y.
Quinlan, J. H.....Toronto, Ont.

Raodo'ph, R. J.....Cincinnati, O.
Redman, G. A. and wife.....Rochester, N. Y.
Reiman, G. L.....Chicago, Ill.
Richards, H. T.....New York, N. Y.
Roberts, W. B.....Rockford, Ill.
Rodman, C. L.....Ravenna, O.
Rollins, E. W.....Denver, Colo.
Rose, P. N.....St. Louis, Mo.
Ross, G. A.....Kansas City, Mo.
Royce, F. W.....Washington, D. C.
Ryan, T. J.....Cincinnati, O.

Sargent, Addison G.....Boston, Mass.
Schiffler, Fred A.....Cleveland, O.
Schlosser, F.....St. Louis, Mo.
Scott, Campbell.....Louisville, Ky.
Scribner, J.....Chicago, Ill.
Scudder, C. R.....St. Louis, Mo.
Searing, George S.....Chicago, Ill.
Searles, A. M.....Chicago, Ill.
Seeley, John A.....New York, N. Y.
Seixas, E. F.....Chicago. Ill.
Sexton, Howard W.....Anniston, Ala.
Seymour, E. W.....New York, N. Y.
Shain, C. D.....New York, N. Y.
Shay, J. H.....Chicago, Ill.
Shrader, Wm.....Columbia, Mo.
Shultz, J. A. J.....St. Louis, Mo.
Shumway, J. N. C.....Taylorville, Ill.
Slater, H. B.....Canyon City, Colo.
Small, H. H.....Chicago, Ill.
Smith, Frank B.....Springfield, Mo.
Smith, H. J.....New York, N. Y.
Smith, T. Carpenter.....Philadelphia, Pa.
Smith, Thos. H.....Denver, Colo.
Smith, T. Perry.....Fayette Mo.
Stacey, Thomas S.....Chicago, Ill.
Stearnes, R. S.....Cincinnati, O.
Stedman Geo. C.....St. Louis, Mo.
Stelling, R. H.....Denver, Colo
Stewart, C. W.....Chicago, Ill.
Stillwell, L. B.....Pittsburg, Pa.
Stockwell, Edward.....Chicago, Ill.
Stump, C. E.....New York, N. Y
Sullivan, M. J.....Chicago, Ill.
Sunny, B. F.....Chicago, Ill
Swetland, H. M.....New York, N. Y.

Tabor, Robert B.....Boston, Mass.
Taft, Benjamin.....Boston, Mass.
Talcott, George F.....Boston, Mass.
Talmage, C. H.....St. Louis, Mo.
Taltavall, J. B.....New York, N. Y.
Taylor, A.....Pittsfield, Mass.
Terry, F. S.....Chicago, Ill.
Tesla, Nikola.....New York, N. Y.
Thebault, T. E.....Chicago, Ill.
Thompson, A. C.....St. Louis, Mo.
Tibbe, A. A.....Washington, Mo.
Tice, Edwin S.....Minneapolis, Minn.
Townley, Calvert.....Pittsburg, Pa.
Tuder, H. C.....Baltimore, Md.
Turner, John.....Cincinnati, O.

Urquhart, D. F.....Boston, Mass.

Valentine, John.....Chicago, Ill.

Wade, E. E.....Colorado Springs, Colo.
Warren, A. P.....Fayette, Mo.
Webb, Herbert Laws.....New York, N. Y.
Western, B. R.....New York, N. Y
Weston, Edward.....Newark, N. J.
White, C. P.....Evansville, Ind
Whitehead, S. E.....Carthage, Mo.
Whitney, L. C.....New Britain, Conn.
Wilkins, E Ward.....Philadelphia, Pa.
Willard, R. S., and wife.....Cuyahoga Falls, O
Wilmerding, C. H.....Chicago, Ill.
Wilshire, J. W.....Cincinnati, O.
Wilson, Fremont.....New York, N. Y.
Wilson, C. E.....Chicago, Ill.
Wilson, C. H.....Chicago, Ill.
Wirt, Charles.....Chicago, Ill
Wood, M. M.....Chicago, Ill
Wood, Jas. J.....Fort Wayne Ind.
Wood, E. E.....New York N. Y
Woods, C. G.....St. Louis, Mo.

Wunder, F A., and wife.....Chicago, Ill.
Wurts, Alex. Jay.....Pittsburg, Pa.
Wyant, Robert E.....Birmingham, Conn.
Young, E. P.....Sewickley, Pa.
Zimmerman, F. C.....Carterville, Ill.

Convention Notes, Exhibits and Personals.

E. W. Goldsmith was on hand to represent the Western Electric company, Chicago.

H. H. Small joined the forces of the Central Electric company, Chicago, at the Southern.

Secretary P. H. Korst of the Badger Electric company, Racine, Wis., came down from Chicago on the convention train.

The popular assistant secretary of the Brush Electric company, Leonard B. LeVake, did the honors for the central office.

E. Ward Wilkins of the Patrick & Carter company of Philadelphia was on hand to explain the merits of his company's goods.

The Okonite Wire company was represented by General Manager George T. Manson, who royally entertained his many friends.

Little pink circulars marked "Insullac" told their own story, and did good work for the Massachusetts Chemical company of Boston.

Charles T. Page of the Englewood Electric Light company, Englewood, Ill., came up on the "Diamond Special" Friday night.

Rockford, Ill., was ably represented by William B. Roberts and George A. Mayo of the Rockford Electric Manufacturing company.

George C. Bailey of Chicago, western manager for John A. Roebling's Sons company, Trenton, N. J., was a visitor at the convention.

Edward Stockwell of the Washburn & Moen Manufacturing company did the honors for his house at the Southern Hotel (page 117.)

Joseph W. Wilshire, president of the Card Electric Motor & Dynamo company, Cincinnati, O., dropped into St. Louis to shake hands with his old friends.

The big belt in the corner of the rotunda in charge of E. P. Atkinson showed that Chas. A Schieren & Co of New York are still doing business at the old stand.

P. H. Hoover of "P & B" fame reached St. Louis over another route than that of the "Diamond Special," but he made his arrival known to the delegates and visitors.

Walter C. McKinlock was on hand to push the National india rubber wire. Mr. McKinlock had no samples to speak of, leaving the good goods to speak for themselves.

H. S. Manning, who is now in charge of central station work for the General Electric company, renewed his acquaintance with many old friends at the St. Louis gathering.

The Boston incandescent lamp was exhibited on a board in the neighborhood of the display made by the Falconer Manufacturing company. Matt M. Merritt displayed the lamp.

It is hardly necessary to say that J. H. Shay of the Munson Belting company could not resist the opportunity that the convention presented of meeting many old friends.

George C. Pyle of Indianapolis, so well known through his work as a designer of electric head lights, was a prominent figure among the delegates in the rotunda at the Southern.

A near neighbor of the sample board of Hart switches was the small display of the Sperry Electric Mining Machine company, consisting of Sperry fuse links and copper terminals (page 117).

Of course C. D. Jenney, of the Jenney Electric Motor company, Indianapolis, Ind., took the opportunity to steal a few days from his business to partake of the convention hospitality.

C. H. Wilson of Wilson & Jackson, contractors, Chicago, attended the convention. Mr. Wilson, it will be remembered, is no longer a telephone man, having gone into the general contracting business.

The popular George S. Searing, although backed by only the small exhibit shown to the right on page 117, left no one in doubt as to the good points of that very meritorious invention, the Hart & Hegeman switch.

The Falconer Manufacturing company of Boston made a small exhibit, illustrated to the left on page 117. This company manufactures incandescent light supplies and has its office and factory at 1 Hartford street, Boston.

M. W. Hayden, of the Law Battery company of New York, renewed his acquaintance with his many friends. It is rumored that this well-known concern is about to bring out an important novelty in the electrical line.

Geo. F. Talcott of the Campbell Electrical Supply company, was on hand, and the little group of samples, at the center of which the Diamond transformer stands preeminent (page 114,) shows that somebody's time was not wasted.

The Falls River Machine company, Cuyahoga Falls, Ohio, although not making what could be called an exhibit, nevertheless attracted attention through the agency of numerous handsome illustrations of electric lighting and power plants A number or blue prints, photographs and any amount of descriptive matter, arranged about a parlor on tables, did good work in keeping the company before electrical men.

George C. Bailey, western manager of John A. Roebling's Sons company, was at the convention. Mr. Bailey did not talk much about business, but it is reported that numerous large orders found their way into his note book.

The well known manufacturer of switches, H. T. Paiste of Philadelphia, spent a few hours in St. Louis during the convention. On account, however, of pressing business Mr. Paiste was obliged to return home earlier than he anticipated.

S. F. B. Morse came down on the convention train from Chicago, and he and Edward B. McClees not only enjoyed life but quietly did a great deal of missionary work that will lead to still more extensive introduction of Day's Kerite.

Who represented the Diehl motor at the convention? No one seemed to know; but, somehow or other, on every chair in the rotunda and throughout the parlors upstairs a little chocolate-colored pamphlet with gold trimmings told its own story.

A convention without General Agent P. C. Ackerman of the American Electrical Works of Providence, R I., would be a quiet affair. He had many pockets they were well filled with solid testimonials in the way of orders from his many friends.

General Manager C. E. Bibber, of the Consolidated Electric Manufacturing company of Boston, showed the merits of his new arc light dynamo by the aid of a complete detail print of this machine, which resulted in several orders for this apparatus.

The big Chapman iron body heavy steam valve, illustrated on page 117, shows that the Chapman Valve Manufacturing company of Indian Orchard, Mass., proposed that electrical steam users should have an opportunity to judge of the merits of its device.

Thomas G. Grier of Chicago started the ball rolling for the Bryant Electric company the moment the Chicago delegates began to gather at the 39th street station. The little note book told its own stories of the Paiste switch and other Bryant devices.

W. J. Hammer, the noted New York electrician and expert, was on hand at the convention. Mr. Hammer visited Chicago before returning to New York, to make arrangements for the quarters of the American Institute of Electrical Engineers at the World's Fair.

Electrical Engineer Wm. P. Bryan was indefatigable in his efforts to do the honors for St. Louis. Mr. Bryan, though, was but one of many that lost their sleep in order that the visitors might leave with a full understanding of what was meant by St. Louis hospitality.

W. H. Ashton of Dayton, Ohio, representing the Dayton Fan & Motor company, was on hand, and his cheerful countenance told the story of a rapidly increasing business. F. J. Pearson of Omaha, Neb , electrical engineer of the Omaha Power company, accompanied Mr. Ashton.

E. G. Barnard of the E. G. Barnard company of Troy, N. Y., left a token of his beneficence with almost every convention delegate in the shape of an elegant card case and pocket-book. These little gifts will serve to remind many that there is on the market a "perfect" arc cut-out.

The Stanley Manufacturing company, of Pittsfield, Mass., was represented by President C. E. Atwater and General Manager Hine, who came with the Chicago party. They expressed themselves as pleased with the business results of their attendance upon this convention.

The Mather Electric company of Boston recognized the fact that electric light men are mechanics, and have to use tools on many occasions. An ingenious pocket screw-driver presented by Chas. I. Hills, will keep the company before the eyes of many electric light men through the coming year.

E. G. Bernard of Troy, N. Y., was in attendance at the convention and had with him several of the Powers arc cut-outs, which he exhibited to central station men, who were much interested in this neat and handsome device, which is already in use on hundreds of arc circuits.

The Missouri Electric Repair company, through Manager E. B. Tyler, did good work in pushing the Eureka tempered copper at the convention. This company makes a specialty of armature winding and commutator work. Its offices are at 16 South 9th street, St. Louis.

H. H. Brooks, secretary of the Circular Loom company of Boston, Mass , was obliged to remain until the convention adjourned on account of the many engagements which he was obliged to keep with the men who desired to investigate his wire. He had expected to be in attendance only one day.

President H. C. Adams of the Phillips Insulated Wire company told the story of the merits of his well-known wire by the aid of that handsome sample case now so well known to every central station man. The illustration on page 114 will give the reader an idea of the appearance of this sample case.

Judge Armstrong headed a jolly party at the Southern. Miss Armstrong, the judge's sister, Miss Morgan and Miss Fortner did the honors. These ladies were most hospitably entertained by the ladies' reception committee and were enthusiastic in their praise of the many courtesies extended. Judge Armstrong and party left for Chicago Friday night. The ladies spent a few days in the World's Fair city and thence they returned to Camden, N. J , to visit Miss Armstrong.

The Consolidated Electric Manufacturing company of Boston was pushing its automatic arc dynamo at the convention. The Consolidated arc dynamo is well spoken of, as are also the company's single and double carbon lamps. The Elkins regulator, too, has many meritorious features.

The Westinghouse company distributed a circular gotten up in handsome style, entitled "The Sawyer-Man Stopper Lamp," which told the convention delegates where the new lamp could be purchased. The illustrations in this catalogue were very fine, and the various features of that much talked-of lamp were fully explained.

Of course F. A. Wunder and wife found their way to the Southern in time to get something of the enjoyment offered by the hospitable St. Louisans. Mr. Wunder makes his headquarters in Chicago, but is of necessity away a great deal of the time, so the convention presented an opportunity for him to see his many friends.

W. H. Ferris, manager of the Enterprise Electric company of St. Louis, availed himself of the splendid opportunity offered at the Southern Hotel and other points during the convention time in St. Louis to remind his good friends among the electric light men that the "N. I. R." wire and cables were among the best in the land.

P. L. Rose, of the Rose Electric Light Supply company, St. Louis, distributed among the convention delegates a neat little card giving the places of interest to visitors in St. Louis. Mr. Rose is doing a flourishing business in electrical apparatus that "has seen some usage." He expects shortly to establish a branch office in Chicago.

Edwin S. Tice, representing the Tice-Lintner Electric company of Minneapolis, was in attendance, but a delayed case of instruments prevented him covering all the ground he had hoped to. The Tice-Lintner Electric company, however, is a name that will stay with many that visited the convention. Mr. Tice made many friends.

To omit a word in mention of the efficient services of James McKearney, electrician of the Southern hotel, would show an inappreciative spirit of one man's hard work. Mr. McKearney is an old Thomson-Houston man and has many friends among the delegates. He has entire charge of a lighting plant of 50 arcs and 500 incandescents.

F. S. Terry, Charles Wirt and D. E. Goe kept the Ansonia Electric company well before the minds of not only the convention people but the local St. Louis buyers as well. The Ansonia company made no pretense at an exhibit, although Mr. Wirt was on hand to show his new meter, illustrated on page 117, to those interested in such apparatus.

Not a few convention delegates wondered why Harry Bishop, general western agent of the Massachusetts Chemical company of Boston, went about with such a smiling face. No one knew, however, except those who had a glimpse into a well filled order book. Mr. Bishop says that his sales of Insullac in St. Louis were beyond his fondest expectation.

A. D. Adams, of the Commercial Electric company of Indianapolis, Ind , spent several days at the convention. Mr. Adams, it will be remembered, read one of the ablest of the convention papers and received a number of compliments for his thoroughly scientific treatment of a subject most interesting to builders desiring efficiency in dynamos.

Of course Fred E. Degenhardt came down with the "boys" on the convention train from Chicago. Mr. Degenhardt did considerable business on the way down, and in consequence felt justified in shaking off business during a few hours at the convention. "There is still only one wire in the market," he says, "and the Standard underground cable is that wire."

The Helios Arc Lamp company of Philadelphia was represented by General Manager D. C. Spruance, who was kept very busy in showing the many admirers of this well known lamp its many prominent features in detail. Among the large orders that he booked during his stay at the convention was one from the Missouri Electric Light company of St. Louis.

E. B. Hatch, general manager of the H. W. Johns Manufacturing company of Hartford, Conn., greeted his many western friends at the convention, and it was evident that they had not forgotten that this company's well known moulded mica was necessary for complete installations of electrical work. Mr. Hatch placed a large number of orders and was correspondingly happy.

Why Wells Goodhue, of Taylor, Goodhue & Ames of Chicago, was one of the best advertised men of the convention is a question that the WESTERN ELECTRICIAN answered on its back cover in the last issue. With that courtesy that characterizes this energetic concern as a whole, Mr. Goodhue added many a name to the already long list of the new firm. Mr. Goodhue did not come for business, but an ingenious little model of the Diamond transformer (page 114) came to the notice of a great many central station men nevertheless.

The Mosher Electric company of Chicago made no special exhibit at the convention, although its lamps were inspected in practical operation at a number of points in St. Louis. President G. L. Reimann and Vice-president J. A. Mosher, however, were on hand to enjoy the convention. Secretary and Treasurer J. F. Sheriffs was unable to attend, but Messrs. Reimann and Mosher made many friends, and the alternating lamp on exhibition at the quarters of the Western Electrical Supply company

and a lamp of direct current in the hall of the Electrical club in the Equitable building aided them greatly in their task of pointing out the many meritorious features that characterize the Mosher apparatus.

The Elkhart transformer and the Meston fan motors for alternating currents were especially pushed at the convention by the Electric Appliance company of Chicago. This concern is now handling a swinging ball lightning arrester, and the long list of testimonials presented in the company's circular distributed at the convention told the story of an unbroken record of success.

People who "took notes" will have good cause to remember J. W. Godfrey of the New York Insulated Wire company, who took advantage of the occasion to advertise not only the well-known Grimshaw insulated wire, but to make better known, if possible, the company's popular general manager by publishing a note book that had for a frontispiece a handsome portrait of Mr. Godfrey.

Geo. J. Jackson, general agent of the Norwich Insulated Wire company of New York, held court in an upper parlor, and his handsome case of wire samples (page 114), representing almost every conceivable sort of insulated wire and cable, reminded the convention delegates that the Norwich company had a "pusher" in the Southern Hotel who was fully capable of pointing out the merits of paper insulation.

The Central Electric company of Chicago lent its energies to the direction of pointing out the merits of the Lundell motors, but William H. McKinlock and Charles E. Brown did their usual good work for the world-renowned Okonite wire. Interior conduits, too, shared their attention, and during the lunch hour on Wednesday there was hardly a man in the rotunda of the hotel who was not reading the *Architects' Electrical Bulletin*.

The Ansonia Electric company (formerly the Electrical Supply company of Chicago) made no attempt at a display exhibit. Charles Wirt, however, was on hand to explain the merits of the ingenious meter that bears his name. The Ansonia Electric company realized that the opportunity was an excellent one for advertising, and circulars without number were distributed among the delegates.

C. B. McClees, one of the pioneers in the manufacture of insulated wires and cables, having been associated for years with "Day's Kerite," which is almost a household word among all users of wire for electrical purposes, was at the St. Louis convention with a fund of information for everybody about cables and a stock of old-time telegraph and telephone anecdotes. Mr. McClees has been spending some time in Chicago and is still here.

Stephen A. Douglas, district manager of the Brush Electric company at Chicago, shook visitors by the hand and appeared totally indifferent to all orders for dynamo-electric machines, but somebody said that there was a man at the convention from the Brush company who managed to get in a great deal of work that might be characterized by the adjective "fine." Mr. Douglas has made a name for himself by his successful handling of the Chicago office of the Brush company.

Word has been received from H. W. Freund, general manager of the Vincennes Electric Light & Power company, to the effect that his company at its recent annual meeting re-elected its present directors and general manager. The company reports a one hundred per cent. increase in business and that $20,000 worth of new apparatus has been installed during the last six months. It is said that the Vincennes company has one of the neatest and best equipped plants in the United States.

Of course, E. F. Seixas of the Chicago & St. Louis Electric Railway company was on hand, and it was generally conceded that General Manager Bleyer of the Chicago office of this enterprise knew his business when he sent such an energetic and hustling representative to the convention. Mr. Seixas didn't carry samples, picture cards or circulars, but it was difficult to find a man at the convention who would say a word against the Chicago & St. Louis Electric railway after a chat with Seixas.

Alexander, Barney & Chapin, of New York, seldom do anything except it be in an effective manner. Their well-known representative, H. G. Issertel, presented the gentlemen attending the Wednesday morning session of the convention handsome boutonnieres. In the afternoon the ladies in attendance were given beautiful bouquets, which were worn at Mr. Tesla's lecture that same evening. Mr. Issertel, as usual, presented his many electrical novelties in such a manner that secured a large patronage for this well-known house.

C. J. Butler, manager of the Indiana Rubber & Insulated Wire company, ran into St. Louis, stealing a day from an extended business trip. Mr. Butler states that he is now busy closing the Chicago office in order that the business might be concentrated at Marion, Ind. The factory is still at Jonesboro, Ind., but he feels that the facilities are better at Marion. The works are now about four miles from the office, and the prospects are that under the new arrangement the business of the company will not only be better systematized but rapidly increased.

Away up in the top, but not entirely out of sight by any means, owing to the energetic efforts of John R. Coffman, general sales agent, was the exhibit of the Eureka Tempered Copper company. This concern is well known in the electrical trade as the sole manufacturers of pure tempered copper. The line displayed by Mr. Coffman consisted of a great variety of samples (page 116), and almost every electrical fixture that might be made of copper was exhibited. A line of commutator segments for all standard arc light machines was shown. There was also exhibited copper trolley wheels, copper brushes, copper bearings, tempered sheet copper, and last but not least of the interesting exhibit were samples of electric street railway motor pinions, also made of copper. It will be remembered that this concern makes a point of being the only manufacturer of tempered pure copper.

D. P. Perry and F. E. Drake of the Standard company, Chicago, excited the admiration of the delegates by an exhibit of Standard lamps operated from the house circuit of the Southern Hotel. Mr. Perry knew his business when he hung two Standard lamps in the rotunda at the Southern Hotel, and it is needless to say that almost every convention delegate had an opportunity to judge of the merits of the Standard weatherproof double service lamp and the indoor single service Standard lamp. The Standard company, through Mr. Perry's energetic efforts, was never in a more prosperous condition than it is to-day.

Treasurer C. E. Newton of the Jewell Belting company impressed himself upon the memories of all those present by presenting each with a handsome folding pocketbook. Pocket folders, however, might have been referred to as the order of the day, for it should not be forgotten that Thos. G. Grier, the pushing young Chicago manager of the Bryant Electric company, started the ball rolling almost before the convention train left Chicago by distributing a pocket folder. This folder carried an illustration showing a prairie train leaving the Monadnock building in Chicago to carry out to the fair grounds a large order of Bryant switches that was recently booked.

Arc and incandescent light globes were the order of the day in room 381 at the Southern, where the firm of James J. Murray & Co., of Philadelphia, presented samples. This company was represented by J. K. Martin, through whose courteous treatment of all visitors the company has undoubtedly made many friends in the western trade. Without going into the entire line of samples displayed, it may be said that almost every conceivable variety of globe that might be needed by an electric light central station man was exhibited (page 115). Mr. Martin is pushing his company's goods in the West, where there is unquestionably a large field for his energetic efforts.

A little late perhaps, in one sense, but well in time as far as effect is concerned, was the Bryant Electric company of Bridgeport, Conn. W. C. Bryant and Thos. G. Grier of Chicago were out bright and early Tuesday morning, but owing to a delayed case of samples, a handsome exhibit (page 117) of china and other well-known types of Bryant switches was not prepared until Wednesday afternoon. But as many things that are last are not least, so it was with the Bryant company, and Messrs. Bryant and Grier werewell repaid for their extra trouble in getting things ready. The Bryant company, it will be remembered, now controls the Paiste switches, K. W. rosettes and specialties, the Cleveland arc cut-outs, etc.

The Electric Construction & Supply company was represented by General Manager R. B. Corry. Mr. Corry did not undertake to make any extensive exhibit, although he had two arc lamps running in connection with the Eddy company's exhibit. These lamps were hung in two windows opening out into the rotunda at the Southern and reminded one that the Electrical Construction & Supply company was in the field to do business. The Ward lamp is already very well known in St. Louis, and there are a large number in practical operation in that city. One of the lamps exhibited was what is known as the "commercial lamp," and the other was a specially designed lamp made in handsome style for interior service.

A. H. Bauer, the electrician of the Pullman company, was called by special invitation from Chicago to New York that he might accompany the convention train to St. Louis and take charge of the electric lighting service. It was rumored, though, that Mr. Bauer was wanted more for his good company than for his services, for F. W. Raven of Wayne, Ill., was the practical man on board the train, under whose personal supervision a most brilliant and successful run was made. The usual Pullman electric lighting equipment was in service on the convention train. The Eckemeyer dynamo, the Little Brotherhood engine, the River and Rail cells, did their work in a manner that left nothing to be desired. All voted that Mr. Bauer knew how to light a convention train.

The General Incandescent Arc Light company of New York made an extensive exhibit of arc lamps. A. G. Noll, superintendent of the company, was in charge of the display. This exhibit contained a number of lamps of unique design. A number of decorative arc lamps on incandescent circuits were shown and central station men were lavish in their praises of the ornamental lamp for interior service. It is a fact that one had to see this exhibit before coming to a realization of how pretty the decoration on an arc lamp could be made. Superintendent Noll, by his courteous treatment of all inquirers, made many friends for the General company. Some idea of the character of the concern's exhibit may be had from the view presented on page 115.

George Cutter of Chicago had the misfortune to be taken ill on the way down to the convention, and although it was the regret of many that the popular Chicago electrical specialist was not on hand in person to tell in his original manner of the "very latest and best thing out," a corps of efficient representatives kept him from anxiety lest the opportunity be lost. The picture on page 117 shows that George Cutter's exhibit was one of the most extensive at the convention. To mention all the different specialties would be to write a catalogue. It may be said that the lamp supporting pulley that Satan's minions have so much difficulty in tearing down made many new friends, as did the Cutler non-inductive volt and ammeter. Mr. Cutter made quite a hit through an ingenious advertising scheme. Every one who came near the Cutter exhibit was immediately seized by either H. I. Hadaway or Frank McMaster, who had charge of the exhibit, and adorned at the buttonhole with a small figure, impossible to describe, for it wasn't a bouquet or it wasn't a rooster, but it served nevertheless to excite curiousity and in that way answered its purpose well.

The Salamander wire, represented by Mr. Stockwell, was pushed for all it was worth. It will be remembered that this is a wire already familiar to convention delegates through the remarkable tests which it has repeatedly withstood in exhibitions given to illustrate its fire proof qualities. The company claims that this wire will not burn if exposed to a flame, and that the conductor can be heated to the melting point without igniting the inside insulation. "Salamander" made many friends, and the few examples exhibited undoubtedly made an excellent impression.

Charles E. Gregory, representing his new organization, the Charles E. Gregory company of Chicago, was on hand. Mr. Gregory has lately changed his profession from that of "a trader in electrical machinery that has seen some usage" to that of "a dynamo utilitarian." The new Gregory company is now offering a complete line of desirable specialties, a number of which were exhibited at the convention. One fixture that excited considerable attention, and which, it was rumored, was the subject of numerous orders, was the Pfluger arc lamp hanger. The Pfluger Acorn double-pole arc switch also excited considerable curiosity on the part of the arc light men present. Mr. Gregory in reality made no pretense at an exhibit, but a glimpse of the apparatus displayed is presented on page 117.

Herbert A. Wagner, of the Wagner Electric Manufacturing company of St. Louis, made an interesting exhibit at his office of his new alternating current motor. The machine exhibited was for an ordinary 50 volt circuit working at 16,000 alternations. The motor was of two horse power and drove a direct current generator supplying a bank of lamps. These Wagner alternating motors are now being built up to ten horse power. Although Mr. Wagner made no attempt to advertise his new motor among the convention delegates, the fact that there was a new type of alternating motor running successfully in St. Louis caused considerable curiosity; in fact, it may be said that although Mr. Wagner may not have been aware of the fact, he had one of the most attractive exhibits at St. Louis.

One of the features of the round of entertainment so generously proffered by the hospitable St. Louisans was the dinner given by Dr. Wellington Adams on Thursday evening to a number of visiting and resident scientists. It is perhaps needless to say that the guest of the evening was Nikola Tesla. The guests from out of the city were Edward Weston, Nikola Tesla, Mr. Bradley, Mr. Scheffler, Mr. Stillwell and Dr. Louis Bell. These gentlemen were invited to meet Prof. Chaplin, chancellor of Washington University, Prof. Pritchett, president of the St. Louis Academy of Science, Prof. F. E. Nipher of the Chicago & St. Louis Electric Railway company and a number of other prominent St. Louis scientists. The menu was elaborate, and Dr. Adams dispensed proverbial St. Louis hospitality.

The Fort Wayne Electric company had an exhibit that excited the attention of lighting men (page 116). Four arc lamps in operation reminded all comers that the Fort Wayne Electric company was keeping well abreast of the times in its manufacture of lamps. C. S. Knight, general agent, and James J. Wood electrician and general superintendent, were on hand to point out the features of merit. There were exhibited one short alternating arc lamp, one double carbon lamp, one short constant potential arc lamp for direct current circuits and one lamp of ordinary length for constant potential direct current circuits. Mr. Wood pointed out that the feature of the new constant potential lamps was that the extra resistance and fuses were all contained in and on the one hanger board, with the switch for the lamp in the lamp proper. This arrangement seemed to be well appreciated, as it simplifies very materially the work of the construction man.

The Singer Fire Alarm company of Buffalo, N. Y., has just completed the organization of a local company in St. Louis. The new location is in the Security building, and a station has been equipped with apparatus sufficient to make connection with 300 buildings. The instruments employed are, however, more strictly speaking, used for the protection against fire. The system is operated on the closed circuit plan, current being supplied from a storage battery. Those who have subscribed to the system state that it is giving great satisfaction and new customers are coming in rapidly. The company has completed its first circuit of three and a half miles, and a number of buildings are being put into the service. Under the new organization Lainie Higgs undertakes the management. Mr. Higgs is well known in St. Louis and Chicago, and under his energetic policy it is only reasonable to presume that the business of the Singer company at St. Louis will advance at a rapid rate.

The two Cutters were there, but they took care to have their exhibits well apart, and, both being favorites with their respective customers, it was a toss up as to which excited the most curiosity with his display of "Cutter" specialties. H. B. Cutter of the Cutter Electrical Manufacturing company of Philadelphia exhibited some switches in his parlor on the second floor (page 117). On one board there were arranged a number of the C. S. switches in such a manner as to show their special points of excellence. There was the C. S. flush double push switch, double pole, single pole and three wire; also the C. S. flush double-push commutation switch, three wire and four wire. In these switches nothing is in sight but an ornamental face plate. The designer claims, too, that they are the only house switches that indicate by the position of the push buttons

the condition of the current at a distant lamp; that is, whether it is on or off. These are, however, but a few of the strong points claimed for these fixtures. Mr. Cutter also exhibited an ingenious device through which incandescent lamps might be lighted by the action of opening a door. A special electrical lock was also shown, designed for use in insane asylums or other institutions where it was desirable that a lamp be lighted by the action of a key opening a door.

General Agent M. E. Baird, A. D. Newton, secretary and treasurer of the Eddy Motor company of Windsor, Conn., "did" the convention in royal style. The Eddy company's exhibit attracted a great deal of well deserved attention. Messrs. Baird and Newton had brought with them from the factory a 15 horse power motor and a 1 horse power motor. These machines had never been exhibited before. They were of entirely new design. The larger machine ran at the slow speed of 600 revolutions per minute and was remarkable for its large and well ventilated armature. The entire machine is compactly built and embodied many ingenious features that go to make up a thoroughly efficient type of motor. A general idea of the new Eddy machine may be obtained from the view on page 115. The 15 horse power motor drove a small Wood dynamo that was connected to and furnished current for two Ward arc lamps. This combination exhibit caused considerable comment that was, needless to say, favorable and would indicate that the Eddy machine of new design will hold its own in the fight for supremecy.

The Interior Conduit & Insulation company had a strong force at hand. The Central Electric company of Chicago, general agent, was represented, and also the special agent, the Southern Electrical Supply company, St. Louis, and these gentlemen, working in conjunction with Romaine Mace, the New York company's special convention representative, did good work in pushing the Lundell motors. The picture on page 115 will give a good idea of the company's small but interesting exhibit. Two Lundell motors, half kilowatt each, were coupled together with a flexible shaft coupling, and one was used as a generator. The idea of arranging the plant this way was to illustrate in a manner beyond dispute the company's claim of an unusual efficiency. Weston instruments were employed, that reliable readings might be obtained. The Interior Conduit Insulation company also exhibited its new combined exhaust fan and motor outfit. This fan is very compact, the motor being entirely inclosed and the fan proper well guarded. The Johnson vice-lock switch for conduit boxes also came in for a well deserved share of attention.

One of the most unique exhibits at the convention was that of Day's Kerite wires and cables, in charge of S. F. B. Morse of Cushing & Morse, general western agents at 22 Dearborn street, Chicago. This exhibit required no parlor or special space, but nevertheless attracted considerable attention. It consisted of five pieces of Kerite insulated wire which had done actual service as follows: (1) Four years and two months under the Milwaukee river carrying 2,400 volts daily without a leak. (2) Fifteen years in a common gas pipe under the streets of Chicago; line still in daily use without fault. (3) Nineteen years in service exposed to wind and weather in Ottawa, Canada; line still in good working order. (4) Twenty-four years on private line erected by Prof. Morse; still in good condition. All these wires were in excellent condition, and Mr. Morse had the original authentic documents with him to prove their antiquity. The last piece was tagged as follows: (5) "This piece of Kerite wire was taken from the hand of a mummy afterward proved to be that of Rameses the Third, who died about 4,000 years before Christ. It was a custom of the ancient Egyptians to bury a piece of Kerite insulation with their dead to signify eternity."

The Weston Instrument company, Newark, N. J., and the Carpenter Enamel Rheostat company, Bridgeport, Conn., occupied a parlor on the same floor with those of the electrical journals. The Weston people were there in force. Edward Weston himself being present, with Charles D. Shaio and R. O. Heinrich. All the various types of the latest improved Weston instruments were displayed. To any one interested in delicate and accurate machinery this exhibit was very instructive. There were shown station voltmeters, potential indicators and ammeters for direct current circuits. The Weston company has just issued a catalogue, which was presented to all visitors, and described in detail a number of recent and important improvements in existing types of instruments, and also several new styles of meters (page 116). The Carpenter Enamel Rheostat company, however, shared the honors with the Weston company, for the Carpenter rheostat has been perfected of late to such a degree that many were wondering how small these compact fixtures could be made, and curiosity led them, therefore, to make more than a casual inspection. Charles E. Carpenter and Charles D. Shain reminded all comers that the Carpenter rheostat took up practically but one-tenth the space that was required for the ordinary old style resistance box (page 114).

C. O. Baker, Jr., master of transportation, was treated to a pleasant surprise on Wednesday afternoon at the Southern Hotel. The convention delegates had agreed to a man that Mr. Baker was deserving of some token of appreciation more weighty than mere word of mouth, and a few of Mr. Baker's many friends on the train quietly went to work to see that this good resolution was put into practice. An elegant silver punch bowl and ladle were accordingly purchased and presented to Mr. Baker. Following are the names that were attached to the set of resolutions which accompanied it: C. S. Hayes, L. C. Whitney, P. C. Ackerman, J. C. Pierrez, Fred W. Royce, A. J. DeCamp, C. H. McEntee, T. C. Martin, E. W. Seymour, C. E. Carpenter, Wm. J. Hammer, H. H. Fairbanks, W. J. Morrison, H. C. Adams, James Ferguson, F. R. Colvin, Louis Bell, Geo. T. Manson, B. E. Greene, E. G. Bernard, Geo. J. Jackson, Benj. R. Western, W. C. Bryant, James A. Pentz, Frank C. Mason, J. D. Miller, E. P. Young, Augustus Noll, M. J. Francisco, H. J. Smith, Fred DeLand, W. J. Johnston, A. D. Newton, M. E. Baird, C. E. Newton, Chas. W. Price, W. F. Osborne, E. B. Hatch, Chas. D. Shain, John A. Seely, B. B. Corey, J. H. Mason, E. F. Peck, W. D. Packard, H. T. Richards, Henry B. Cutter, R. O. Heinrich, Frank A. Magee, J. B. Taltavall, T. Carpenter Smith, Fremont Wilson, William Smith Harvey, Wilson S. Howell, H. M. Swetland, Nelson W. Perry, E. E. Wood, Louis Cassier, A. I. Jones, A. H. Manwaring.

A combination of exhibits was to be seen in parlor 54. The Electric Selector & Signal company of New York, the C. & C. Motor company of the same city, and the Interior Conduit company presented an interesting assortment of apparatus. C. P. MacKie, general manager of the Selector company, Robb MacKie and H. Laws Webb were on hand to point out the interesting features of this novel and useful apparatus. This apparatus is already well known to station managers, it having been exhibited at previous conventions. In a word, the purpose of the individual cut-outs, as the principal portion of the Seltector company's apparatus is called, is to enable the dynamo man or switch-board attendant in a central station to cut in or out any lamp, group of lamps or motor on any circuit at any given time without disturbing other lamps on the same circuit. Since the exhibit at the last convention in Buffalo, the apparatus has been perfected in many details, and to-day the company feels that it is about as near perfection as is possible to bring it. Many central station men watched the operation of the individual cut-outs, which were shown in full working order as applied to various classes of service. The C. & C. company's exhibit was operated in conjunction with that of the Selector company, to furnish current for the latter's outfit. A 7½ horse power 500 volt motor driven from the city circuit was attached to a 6 kilowatt 110 volt compound C. & C. dynamo, and this last named machine was connected to the Selector company's apparatus. The C. & C. company was well represented by General Manager Hall of New York and A. Mitchell. These gentlemen together with C. E. Wilson of Chicago and E. B. Matlack of St. Louis, left no chance for the illusive delegate to escape without having had impressed upon him the merits of C. & C. apparatus. This display is shown on page 114.

Electrical Shot Firing in Mines.[1]

By F. Brain.

About 150 years ago Benjamin Franklin first proposed that a spark from an electric machine should be used for firing a cartridge of gunpowder. It was not, however, until 1835 that this proposition was adopted and applied practically. Between 1835 and 1840 some very useful work was done by Sir Charles Pasly with electric exploders, in blasting the hulks of wrecked vessels on the British coast. In those days a Daniell and afterward a Grove and a Bunsen battery was used. These have subsequently given place to the Leclanche battery. In all these cases the current of electricity is of low tension, and the exploding apparatus is bulky. Recognizing the necessity of having an instrument that takes up much less space and is much lighter, electricians have devoted a good deal of attention during recent years in inventing high tension apparatus that would be easy to carry about, especially in mines and rock excavations. Most of these consist of ebonite friction plates with suitable collectors and condensers, but the latest type consist of small magneto electric machines. The fuses used with the high and low tension currents are naturally quite different from one another. The low tension fuse consists of two copper terminals, fixed at a certain distance apart by an ebonite head and connected by a fine platinum wire. This platinum bridge is embedded in fine gunpowder or other explosive, and inclosed in a cup. The head thus prepared is inclosed in a detonating cap containing a small amount of fulminate of mercury, and this in turn is inserted in whatever explosive it is desired to fire. In the high tension fuse the bridge of fine wire is dispensed with, and in its place is used a sensitive chemical composition which explodes on the passage of the electric current through it. The high tension generator presents another advantage over the low tension apparatus, because it is much surer in its effect. A chemical battery is irregular in its action owing to polarization, and it is usually necessary to test it before each firing. This, of course is dangerous. A high tension generator is, however, almost certain in its action, and there is therefore no need to test it. A high tension apparatus, for firing one or two shots, measures 6½ in. by 5½ in. by 5½ in. and weighs 5¾ lbs.

The use of electric fuses is highly necessary in mines where there is any firedamp. During recent years many flameless explosives, such as roburite and tonite have been largely adopted in place of gunpowder in fiery mines, but the charges in most cases were at first, and in many cases still are, ignited, by the ordinary time fuse. This is really just as dangerous as if a gunpowder charge were used. An electrically ignited fuse is the only really safe exploder for a fiery mine. It is also extremely useful when several shots are to be fired simultaneously. It is also safer, because while the time fuse can hang fire, an electric fuse never does, and thus accidents cannot occur from workmen going to replace an apparently ineffective fuse.

Very great exactness is necessary in all operations connected with electric shot firing. The instructions given by the Electric Blasting Apparatus company, with its magneto electric exploders, will therefore be of considerable interest.

Charging.—In charging a shot hole, great care should be exercised; 1st, that the electric detonator is inserted and secured in the explosive; 2d, that the fuse wires are kept straight from the explosive charge along the side of the shot holes; 3d, that the tamping used is not of a gritty or cutting nature; 4th, that the leading wires are not abraded, kinked or otherwise damaged during ramming; 5th, that the joints between the ends of the fuse wires and the ends of the firing cable are perfectly made by the copper wires being quite clean, bare and well twisted together; 6th, that the ends of the firing cable connected to the terminals of the exploder are clean, bare and firmly screwed down.

Firing.—In firing a shot great care must be exercised; 1st, that the firing cable wires are not connected to the terminals of the battery while any workman is at the face, while the shot hole is being charged, or while the fuse wires are being connected; 2d, that the operator's hands do not touch the terminals of the exploder; 3d, that the handle of the exploder is turned with a firm, quick action three or four complete revolutions and then—and not till then—while still keeping up the speed, the knob firmly pressed to fire the charge. The strength of the current mainly depends on the speed of the handle.

Faults.—1st, the constant use of the cables causes the insulation to become rubbed off and a short circuit is the result; 2d, the wires sometimes get injured in tamping; 3d, the fuses are often faulty by damp and are sometimes not adapted to the particular shot to be fired.

Connecting.—Where several fuses are being fired simultaneously, they should be connected in parellel, and not in series.

Conditions.—The form of exploders, cables, fuses, etc., depends on; 1st, the explosive used; 2d, the length of firing cable; 3d, the length of fuse wires; 4th, the conditions of working, whether the holes are wet or dry, whether a pit is being sunk, a heading made, or the coal face being worked.

Magnets.—With magneto-electric exploders, the magnet gradually gets weaker, and should be tested by hand or voltmeter from time to time.

1. Abstract of paper read before the Southwestern branch of the National Association of Colliery Managers of Great Britain.

The Electric Furnace.[1]

It is not a little singular that the first serious attempt to use the heat of the electric arc, though proposed for reducing purposes half a century ago, was in a purely industrial process—namely, that of Cowles for the production of aluminium-copper alloys—instead of for purposes of research such as readily suggest themselves. The oxygen furnace, as distinct from the oxy-hydrogen blow-pipe, has been in the hands of every technical chemist requiring high temperatures for some time, but the number of those using the more powerful arrangement, which owes its origin and efficiency to the ease with which electrical energy can be converted directly and automatically into heat, is not yet great. M. Moissan, whose name is well known on account of his investigations on fluorine—the isolation of which he is said to have effected, although that is not yet placed beyond doubt—has lately turned his attention to the behavior of various refractory oxides when subjected to the intensely high temperature that can be obtained from the arc under proper conditions. The material of which the furnace was made was lime, as in the case of the arrangement ordinarily used for melting platinum by means of an oxy-hydrogen jet, but in this instance the single entrance hole was replaced by two, disposed opposite each other for the reception of the electrodes, as in the Cowles furnace. In the most powerful apparatus used a current of 450 amperes at a pressure of 70 volts was employed, and a temperature of about 3,000 degrees C. was attained. It must be remembered, in comparing this temperature with those that are given in text books as the fusing points of refractory substances, that recent improvements in pyrometry have shown that all temperatures above 1,000 degrees C. have been hitherto over-estimated, sometimes grossly, and that the highest temperature industrially reached is about 1,500 degrees C., and even this is not common. The results obtained by means of this electric furnace are, as might be supposed, of the most remarkable character. At a temperature of 2 500 degrees C., lime, strontia and magnesia crystallize in a few minutes, and if that temperature be exceeded, the material of which the furnace body is made runs down like water. One would like some information as to the purity of the lime before accepting this statement unreservedly, as the presence of inconsiderable quantities of impurities, notably acid oxides, materially affects the refractoriness of lime and other basic materials. However this may be, it appears that the lime is reduced to calcium at this point, another instance being afforded of the enhanced reducing action of carbon at high temperatures which found application in the Cowles furnace, even against the teachings of thermo-chemistry, arguing from data true at more ordinary temperatures. Another phenomenon, equally characteristic of reactions taking place under such conditions, is the formation of a carbide of calcium, which is fusible at red heat. Magnesia affords no solution of the problem of producing a furnace capable of withstanding the action of a powerful arc, as its fusion can be accomplished in the same way as that of lime. Crystallized alumina has been familiarized to us by the researches of Fremy and Verneuil on the production of artificial rubies, and the announcement that at a temperature of 2,250 degrees C. it fuses and crystallizes on cooling is less startling than the news of the comparative ease with which molten lime may be obtained. The addition of a small quantity of chronium oxide causes the formation of small rubies, but they are inferior to those that have been already produced by other methods. If any deduction can be drawn as to the method of their production in nature, it is rather that the mineralizing process has been less intensely plutonic than one was formerly inclined to believe. The most noteworthy fact in connection with the behavior of alumina in the electric furnace is that on continuing the treatment it can be completely volatilized. This

1. From London *Industries*.

is not altogether without parallel, as some time ago an account of experiments by Seger was published in these columns, which went to show that silica was similarly volatile at very high temperatures. Chromic oxide, manganese dioxide, ferric oxide, nickel oxide, and cobalt oxide all underwent change, the higher oxides being reduced to the lower compounds and the resulting products crystallizing at temperatures below the maximum obtainable. Titanic acid could also be crystallized, fused and volatilized according to the temperature used. Zinc oxide volatilized freely, and was deposited in long transparent needles. With such a powerful piece of apparatus, even more important contributions to our knowledge should shortly accrue.

CORRESPONDENCE.

New England Notes.

BOSTON, MASS, March 4.—President Whitney has submitted his plan for securing rapid transit to the legislature. He proposes starting from Pleasant street taking a strip along Carver street wide enough for four tracks for surface cars, running through by an open cut to Eliot street. From there they would pass underground by a tunnel built on the Greatbead plan. This tunnel would follow the edge of the Common on Tremont street to Park street, under the Park street church, the Granary burying ground, Pemberton square to Howard street, about 200 feet west of the intersection of Court street and Tremont row. The tunnel under the Common is to be similar to the Fourth avenue tunnel in New York. There would be an opening six feet wide into each tunnel every 30 feet. The plan is to start with six tracks, four for the surface cars at the start and two for the elevated system finally. This plan contemplates a widening of Broadway as far as Tremont street, of Washington street from Dover to Broadway. Tunnel stations at West street and Pemberton square are contemplated. Boylston street cars would pass underground before they reached Charles street and come along a strip of the Common on Boylston street till they reached the station in the Common at West street. Cambridge street is to be widened and cars coming in from Cambridge and Somerville would strike the tunnel at the northern end and pass through the heart of the city underground. An elevated system would begin at Carver street where the cars come out of the tunnel and gradually rise to the "L" and go to Roxbury in this way. This line could also be continued across Broadway to South Boston. The cars coming out of the northern end of the tunnel would rise on an elevated structure leading to Sullivan square, Charlestown. Elevated structures could also be extended to Somerville and Cambridge if desired. The length of the tunnel proposed is about 1⅛ miles, and the elevated system 7½ miles. The estimated cost of the tunnels is from $5,000,000 to $6,000,000, the elevated roads from $5,000,000 to $8,000,000. President Whitney also said that the West End did not feel able to go ahead on such a system unless protected by the legislature, so that capitalists would have confidence in the permanency of the affair and so enable the road to procure money cheaply. "My belief on this," said he, "is that the legislature should say to us that we are free to go ahead and solve this problem as a business enterprise provided you devote your earnings to the work. For the last five years the average increase in the earnings of the West End has been $1,000 a day; that is, five years ago we carried 105,000 less a day than we do now."

Governor Cleaves of Maine has returned to the legislature without his approval a bill granting a charter to the Auburn & Mechanics' Falls electric road. He did this because he is opposed to special acts for this purpose and wants all such roads to obtain charters under the general law.

A peculiar suit has risen in Connecticut over the burning of the opera house in Middletown. O. Vincent Coffin, a lawyer, is the president of the opera house corporation and also of the insurance company that insured it. When it was burned the insurance company, through its president Mr. Coffin, promptly paid to the president of the opera house corporation, Mr. Coffin, the amount of the insurance. Now Mr. Coffin, as president of the insurance company, brings suit against the Middletown Electric Light company for $40,000, claiming that the burning of the opera house was due to improper insulation of the electric wires. Mr. Coffin, in his capacity as a lawyer, conducts the case, and whether he wins or loses he will have to pay over to himself for legal fees a goodly sum from his insurance company. Taking it altogether Mr. Coffin is getting a good deal of business out of a small fire.

Dr. W. T. Talbot, a member of the Massachusetts Homœopathic Medical society, has introduced in that society a resolution providing for the appointment of a committee of physicians "to investigate the injurious effects of the trolley system as employed in Boston, and its relation to certain diseases of the nervous system, and to report to the board of public health." Dr. Talbot says he has no evidence of any cases of injury to the nervous system, but he thinks the matter ought to be investigated as a professional duty.

The Grand opera house of Boston is to utilize the big search light which was on the top of Mt. Washington last summer as an advertising medium. The owners of the opera house have leased it and will have it placed on top of the theatre, and soon there will be no privacy within seventy-five miles of Boston when the operator takes it into his head to illuminate a dark corner of the suburbs.

The electrical railway interests of New England are being rapidly consolidated. The *Boston Journal* claims to have information that a big New York syndicate is operating in this field as well as the Philadelphia syndicate, which bought the north shore lines.

J. C. E.

PERSONAL.

Benj. Pearson, representing the Fuel Economizer company of New York, was in Chicago last week.

General Bingham and Mr. Gillett of the United States Army were entertained at the Chicago Electric club last week by Lieut. F. B. Badt and F. W. Horne.

Prof. H. S. Carhart of the University of Michigan was in Chicago last week on business connected with the World's Electrical Congress, of which he is secretary.

Prof. Edward Weston of Newark, N. J., was in Chicago Monday. Prof. Weston had attended the St. Louis convention and took occasion to visit Chicago at the close of the meeting. He was entertained at the Electric club by Prof. F. B. Badt.

At the Chicago Electric club last week R. I. Sloan, chief engineer of the Chicago Alley "L" road, entertained George Allen of New York and Mr. Appleton of Chicago. Benj. Williams entertained C. H. Ferguson, L. A. Spicer, J. K. Stearns, W. N. Sattley, Ira J. Mann, Dr. Fuller and Messrs Weidenfeller and Tillinghast.

NEW INCORPORATIONS.

O'Neill Electric Light & Power company, O'Neill, Neb.; capital stock, $25,000; owning, operating and maintaining an electric light and power plant at O Neill, Neb.

Panther Valley Electric Light, Heat & Power company, Lansford, Pa.; capital stock, $10,000; supplying light, heat and power or any of them by electricity to Lansford and vicinity.

Jessup Rapid Transit company, Scranton, Pa.; capital stock, $24,000; constructing and operating an electric railway in Lackawanna county, Pa.; Chas. H. Welles, Scranton, Pa.

Scranton & Carbondale Traction company, Scranton, Pa; capital stock, $10,000; constructing and operating motors and cables, etc.; T. D. McClathery, Drexel building, Philadelphia, Pa.

Lehigh Valley Traction company, Allentown, Pa; capital stock, $75,000; constructing and operating an electric railway in Lehigh county, Pa; Kauffman & Reninger, Allentown, Pa

Jersey Shore Electric Light, Heat & Power company, Jersey Shore, Pa.; capital stock, $5,000; supplying light, heat and power to Jersey Shore and vicinity; Capt. P. D. Bricker, Harrisburg, Pa.

Schuylkill Highlands Railway company, Norristown, Pa.; capital stock, $100,000; constructing and operating an electric railway in Montgomery county, Pa.; M. M. Gibson, Norristown, Pa.

Monongahela City Street Railway company, Pittsburg, Pa.; capital stock, $30,000; constructing and operating an electric railway in Monongahela City, Pa.; J. A. Beatty, 77 Diamond street, Pittsburg, Pa.

Meadville Street Railway company, Meadville, Pa; capital stock, $30,000; constructing and operating an electric railway at Meadville, Pa.; Lyon, McKee & Sanderson, 118 Diamond street, Pitttburg, Pa.

North Bend & Kettle Creek Railroad company, North Bend, Pa.; capital stock, $150,000; constructing and operating a steam railroad in Clinton and Potter counties, Pa.; Johnson & McNarney, Emporium, Pa.

Inter-state Traction company, Philadelphia, Pa.; capital stock, $60,000; constructing and operating motors and cables or other machinery for supplying motive power; A. Simes, 513 Girard building, Philadelphia, Pa.

Lancaster & Downington Street Railway company, Lancaster, Pa.; capital stock, $1,000,000; constructing and operating an electric railway in Lancaster and Chester counties, Pa.; Weiss & Gilbert, Harrisburg, Pa.

Crosstown Street Railway company, Columbus, Ohio; capital stock, $2,000,000; constructing and operating street railroads in Columbus, to be operated by electric, steam, horse or other power; Cotton H. Allen, Columbus, Ohio.

Powelton Avenue and Thirty-fourth Street Passenger Railway company, Philadelphia, Pa.; capital stock, $20,000; constructing and operating an electric railway in Philadelphia, Pa.; John S. Freeman, 400 Chestnut street, Philadelphia, Pa.

East St. Louis Belt Suburban Dummy or Electric Railroad, East St. Louis, Ill.; capital stock, $500,000; to construct and operate a suburban or dummy or electric railroad in East St. Louis, Venice, East Carondolet and Madison; Gross & Gross, 105 North Main street, East St. Louis, Ill.

Phœnixville Electric Street Railway company, Phœnixville, Pa.; capital stock, $50,000; constructing and operating an electric railway in Chester and Montgomery counties; Hannis, Parrish & Williams, 526 Drexel building, Philadelphia, Pa.

Philadelphia & Allentown Electric Trunk Railway company, Philadelphia, Pa.; capital stock, $1,000,000; constructing and operating an electric railway from Allentown to Philadelphia, a distance of 100 miles; H. S. Cavanaugh, Easton, Pa.

Altoona Electrical Engineering & Supply company, Camden, N. J.; capital stock, $15,000; to carry on and construct a general construction business in connection with electric light, power and railway plants, etc.; F. A. Armstrong, Camden, N. J.

Queen City Railway company, Dallas, Texas; capital stock, $400 000; to procure franchises, construct, build, equip, purchase, own, acquire, maintain and operate street railways in the state of Texas, and more particularly in the city and county of Dallas, Texas; Bookhout & McLaurin, Dallas, Texas.

Western Telephone Construction company, Chicago, Ill.; capital stock, $100,000; to manufacture, buy, sell, lease and deal in electrical apparatus and material; construct and operate telephones or electric service exchanges, buy, sell, lease or deal in patents relating to the electrical industry; Kerr & Barr, 189 LaSalle street, Chicago, Ill.

ELECTRIC LIGHTING.

The town of McLearsburg, Ill., has contracted for an electric light plant.

The Electric Light & Power company of Platteville, Wis., has increased its capital from $10,000 to $20,000 in contemplation of improvements.

The right of way is being secured at Kissimee, Fla., and the site has been selected for an electric light plant which has been projected there.

The city council of New London, O., has granted a franchise to the Norwalk Electric Construction company, to erect a plant at New London.

The Redlands, Cal., Electric Light & Power company will hold a meeting of stockholders on April 10th for the purpose of issuing bonds for $50,000.

The Charlotte, N. C., Electric Light company will enlarge and increase the capacity of its plant, and perhaps erect during the year a new and much larger station.

The municipal authorities of Ployesti, Roumania, are inviting tenders until March 10th for the concession for the electric lighting of the town for a period of thirty years.

The electric installations which are being made by Messrs. Siemens of London on the Campania and Lucania, the two new Cunarders, are in keeping with the other marvelous details of these vessels. There are four sets of generating plants in each ship, and each consists of a Siemens dynamo coupled direct to a Bellis engine, which runs at the rate of 280 revolutions a minute and gives an output of 42,000 watts. This is capable of supplying the 1,350 16 candle power incandescent lights—including eight large reflectors of eight lights each for working cargo—throughout the ship, and in addition a powerful search light for facilitating the navigation of the ship. The large switchboard for controlling the lights consists of thirteen sections so arranged that each may be connected with any of the four dynamos. From these dynamos and this large switchboard there runs through each ship upward of forty miles of wire.

ELECTRIC RAILWAYS.

An electric road from Ashbourne to Cheltenham, Pa., is to be built.

An electric road from Augusta, Ky., to Brooksville and Millford is projected.

A company has been formed with a capital of $100,000 to build an electric line to the outlying coal mining towns near Florence, Colo. An electric light plant is also to be operated in connection with the railway.

The city council of Evanston, Ill., has granted the Evanston & North Shore Electric Street Railway company the franchise for a railroad through two miles of Evanston streets. The route of the road is along Chicago avenue from the south city limits of Chicago to Dempster street, then west on Dempster to Sherman, and north on Sherman avenue to Emerson street.

The application of the General Electric company for a receiver for the Little Rock, Ark., Street Railway company has been denied. The chancellor said that the plaintiff's claim is a simple contract debt with no lien to secure the payment of it upon the property of the railway, and the debt is strenuously denied by the company. He concluded by saying that if left alone he felt satisfied that the street railway company would pay. As soon as this decision was announced the Thomson-Houston people filed attachments against the company, which were immediately followed by another attachment in the name of the General Electric company of New York. The property was turned over to the sheriff, who will operate the lines of railway until the attachment proceedings can be heard. The Chicago office alleges that the defendants are indebted in the sum of $186,631.46, while the General Electric company says that the street railway company owes it $6,365.15. It also alleges fraud and asserts that the street railway company has disposed of a great portion

of the capital stock. Before the attachments were issued over $1,000,000 of the capital stock was transferred by President Allison and Secretary Brown to S. W. Fordyce and others. Before disposing of the case Chancellor Carroll issued orders enjoining the Thomson-Houston company from negotiating the $170,000 in notes and ordered that they be held subject to the order of the court. The National Bank of Commerce of St. Louis was also enjoined from disposing of the $120,000 income bonds. The case will be heard on its merits at the April term of the Chancery Court.

ELECTRIC MINING.

An underground electric haulage plant will be installed in the Lake Angeline iron mine, Ishpeming, Mich., by the mining department of the western office of the General Electric company. It is calculated that the mining company will save eight cents per ton of ore by employing the electric system.

The electric power and lighting plant installed in the Dardanelles mine, Placer county, Cal., consists of a 25 horse power Keith electric generator, a 6 horse power electric pump, a 6 horse power electric hoist and 50 incandescent lamps. The electric plant was substituted for the cable transmission previously used. The Dardanelles is a gold mine worked by the drift method. This necessitates the use of a tunnel one-half mile long through the rim rock. At the inner end of this tunnel is an incline of 330 feet, up which all the water and gravel from the mine must be raised before passing out to the mill through the tunnel. The power to run the pump and hoist used before the electric plant was installed was conveyed to them through the tunnel by the use of a wire cable one mile long. The expense of keeping this cable system in working order was enormous when renewals, delays and damages were taken into account. Two cables costing $1,430 were worn out each year, and many delays were caused by the stranding of the cable, which necessitated frequent repairs and the consequent delays. By the substitution of power transmission by electricity, the expense has been reduced to the minimum, so that the initial expenditure of power has been decreased fully three quarters. This is an important matter, especially as during four months of each year steam power must be used, because the water power belonging to the mine, and used during eight months, is not then available. Three cords of wood were used each day to run the cable, but less than one cord is necessary by the electric system, even when the 25 electric lights in the tunnel and incline are continually lighted. The further saving of wear and tear is of much importance. No additional men to those otherwise employed in the mill and mine are engaged in operating the electric plant.

TELEGRAPH.

For a year or more bronze has been used for telephone and telegraph wires with success, and in damp districts, such as the sea coast or where fog prevails, a compound wire consisting of a steel core with an outside layer of copper has been employed. Dr. Elsasser, of Berlin, states that a new kind of telephone wire is being experimented with in Germany. This wire consists of an aluminum bronze core with a copper bronze envelope. It is said to have a low electrical resistance and is of great tensile strength.

TELEPHONE.

The D'Unger Electrical Telephone company, Chicago, announces that it is ready to sell telephones for private lines. The public is familiar with the D'Unger instrument.

TRADE NEWS.

The Shawmut Fuse Wire company of Boston has issued an attractive pamphlet on "Fuse Wire and Its Use," which contains practical information about this indispensable feature of electrical apparatus. Motormen and others will find much of value in this little book.

The Austin Electric Light company, Austin, Minn., is about to install an 80 horse power tandem compound Ball engine, built by the Ball Engine company, Erie, Pa. F. R. Dravo & Co., Pittsburg, representatives of the Ball Engine company, have the contract for furnishing the new Horne building of Pittsburg with two 100 horse power Ball engines.

The Nowotny Electric Company, Cincinnati, O., reports active business in the sale of electric light apparatus in the month of February. This company received orders for two 300 light incandescent dynamos and three steamboat electric light plants, beside a number of small orders for arc lamps and motors. This company holds itself in readiness to furnish electric light apparatus of any standard make.

The plan of heating with the exhaust steam from the engines at electric stations is proving to be a popular and paying investment. The Springfield, Ill., Electric Light & Power company, it is claimed, will this winter realize from its exhaust steam—a waste product—about $3,000. The Ottumwa Electric Street Railway company will realize an income of $15,000. These plants were built by the American District Steam company of Lockport, N. Y.

The Clark Electric company, 192 Broadway, New York, has a high reputation for arc lamps for use on incandescent circuits. These lamps have been in use over three years and no complaints have been made against them. It seems to have been the aim of the Clark company to excel all others in arc lighting apparatus for high efficiency and durability and to cover the entire field of arc lighting. Mr. Clark, the electrician of the company, has brought out an arc lamp for use on 50 volt alternating circuits, taking anywhere from four to twenty five amperes, as may be desired, and the light is as steady as the best arc lamp ever produced. There are no separate appliances for the lamp, and it can be used for any interior lighting and all classes of outdoor work and without hoods. The hum in the arc, owing to the alternations in the current, is overcome almost entirely. When the current is turned on, the full light is secured at once. There is no sputtering or hissing. Any ordinary workman can take care of it, and there is nothing complicated about the lamp in any respect.

The Ansonia Electric company, corner of Randolph street and Michigan avenue, Chicago, formerly the Electrical Supply company, makes a specialty of the Edwards electric door opener, and constantly carries a large stock. Many contractors will use none but the Edwards opener, as it is very compact, suited for either right or left hand doors, and no amount of pressure against the door will prevent it from being opened as easily as when there is no pressure. This company also manufactures the Diamond carbon battery, the demand for which is continually increasing.

The Clayton & Lambert Manufacturing company of Ypsilanti, Mich., is exploiting a fire pot for plumbers and wiremen. It is known as "No. 1 fire pot," and is said to be simple in construction, made of the best material and put together by mechanics skilled in the specialty. A strong air pressure makes it a miniature blast furnace, producing a clear, blue flame, devoid of smoke or dirt and having an intensity of heat hardly credible. No wind is heavy enough to extinguish the flame, and the furnace is so compact and light that it is especially adapted for taking out on jobs.

The McGuire Manufacturing company of Chicago has established a Canadian branch at St. Catherines, Ont., and is prepared to furnish on short notice all the different types of McGuire trucks for electric, cable and horse railways. In making its trucks in Canada the company avoids the heavy duty (35 per cent.) imposed on American built trucks, and can deliver them at all Canadian points at a comparatively slight increase on the prices for Chicago delivery. The company has received a large order from the Niagara Falls & River Railway company of Niagara Falls, Ont., and will build the trucks at its Canadian works.

The Premier Steel company of Indianapolis, Ind., has opened a Chicago office at 319–320 Manhattan building, for the purpose of exploiting a new elevator which it is just perfecting. J. Harrie Hogan will represent the elevator department of the Premier company in the West. The elevator which the Premier company will install is built after the designs of F. E. Herdman, the present engineer and superintendent of the elevator department of the company. Mr. Herdman is a thoroughly experienced mechanical and electrical engineer and is already well known as a man of original ideas in his particular line of work. He is well fitted to design apparatus requiring perfection in detail. The Premier company intends to pursue an aggressive policy, and it is needless to say that Mr. Hogan is well fitted to carry out this policy.

The crop of World's Fair hotels in Chicago affords a fine harvest for all departments of the building trades, which includes, of course, electrical devices. In this direction the Ansonia Electric company, formerly the Electrical Supply company, corner of Michigan avenue and Randolph street, seems to be holding its own. This company does no construction work itself and is somewhat handicapped when it comes to bidding on complete jobs, but it has recently sold the entire electrical apparatus for some of the largest hotels now being built for the accommodation of World's Fair visitors. One of its latest orders is for a 250 number Ansonia gravity needle annunciator. Some of the largest hotels in the city are now running all of their electric bells and alarms with the Diamond carbon battery, which is manufactured by this company. The sales of the Eureka bell, both iron and wood box, are rapidly increasing.

The new Mosher arc lamps for alternating circuits are now in the market, and the Mosher Electric company, their manufacturer, is now in a position to furnish them as demanded. The new Mosher alternating lamp is of neat design. A special feature claimed for the lamp is that it requires no extra resistance. It is wound for circuits of from 50 to 55 volts pressure. This lamp was exhibited at the convention at St. Louis, and those who saw it will remember that the carbon is controlled by a rotary motion. All connections are made in such a way that it is impossible for them to get loose and rattle. The Mosher company realized that a rattling and singing alternating lamp is most objectionable, and the aim was to overcome this difficulty. In accomplishing this result the designer made many experiments to perfect the wearing parts, and so construct them that the natural "lost motion" is taken up automatically. The new Mosher alternating lamp is referred to by the company as "Style F 13." The direct current Mosher lamps are already well known to the electrical fraternity. The lamps now turned out by the company are the result of four years of experiment and thoroughly practical tests. Generally speaking, in the construction of the Mosher lamps both a clutch and a clock feed are used; clutch feeding mechanism is used in multiple arc work, and the clock feed is employed when the lamps are to be operated in series. The lamps are provided with all the necessary switches, cut-outs, etc., and, generally speaking, the arrangement is such that when the carbon is burned up the lamp will be automatically cut out of the circuit. All those investigating arc lamps should give the Mosher lamps a careful inspection before placing their orders.

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ELECTRICAL PATENTS.

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492,394. Insulator Bracket. William N. Eichberg, Chicago, Ill.

492,398. Closed Electric Conduit for Railways. Adolph Heiser, Chicago, Ill.

492,402. Electric Train Controlling Apparatus. Frank E. Kinsman, Plainfield, N. J.

492,403. Means for Operating Throttle Valves of Steam Engines. Frank E. Kinsman, Plainfield, F. J.

492,422. Battery Jar. James F. McLaughlin, Philadelphia, Pa.

492,456. Switch for Operating Shunt Wound Electric Motors. Frederick H. Berry, Milwaukee, Wis.

492,457. Electric Railway Block System. Francis Blackwell, Boston, Mass.

492,467. Long Distance Electric Telephony. Charles M. Haynes, Omaha, Neb.

492,471. System of Combined Telephony and Telegraphy. Frank A. Pickernell, Newark, N. J.

492,478. Electric Burglar Alarm. Charles F. A. Sturts, San Francisco, Cal.

492,480. Transformer and Means for Developing Rotary Magnetic Fields. Charles S. Bradley, Avon, N. Y.

492,482. Signaling Apparatus and Circuit. Edward J. Hall, Morris, and Frank A. Pickernell, Newark, N. J.

492,483. Busy Signal for Telephone Circuits. Edward J. Hall, Morris, and Frank A. Pickernell, Newark, N. J.

492,484. Telephone Central Station Circuit. James L. McQuarrie, Boston, Mass.

492,486. Coin Controlled Machine for Administering Electricity. William R. Pope, New York, N. Y.

492,492. Electric Car Brake. Wendell C. Fletcher, St. Louis, Mo.

492,493. Automatic Speed Indicator and Recorder. Wendell C. Fletcher, St. Louis, Mo.

492,497. Electric Signaling Apparatus. William H. Kenyon, New York, N. Y.

492,519. Electrical Annunciator. John R. Hard, New York, N. Y.

492,523. Ceiling Pan. Franklin H. Beers, Newark, N. J.

492,524. Electric Motor. Franklin H. Beers, Newark, N. J.

492,526. Multiple Switch for Overhead Trolley Lines. William H. Brodie, New York, N. Y.

492,544. Lightning Arrester. Charles F. Scott, Pittsburg, Pa.

492,545. Electric Signaling Apparatus. Wesley Trafford, New York, N. Y.

492,547. Thermostatic Fuse Device. Alexander J. Wurts Pittsburg, Pa.

492,548. Lightning Arrester. Alexander J. Wurts, Pittsburg, Pa.

492,549. Lightning Arrester. Alexander J. Wurts, Pittsburg, Pa.

492,563. Keyed Musical Instrument Actuated by Electricity. Paris E. Singer, London, England.

492,587. Telephone Tablet. John Pruyo, Chicago, Ill.

492,627. Apparatus for Electrically Propelled Cars. Charles J. Kintner, New York, N. Y.

492,633. Electric Lighting System. Robert W. Rollins, Hartford, Conn.

492,645. Electric Railway Signal. Howard St. C. Wait, New York, N. Y.

492,649. Lightning Arrester. Thomas W. Wheatley, Wilkesbarre, Pa.

492,650. Electric Arc Lamp. William P. Wiemann, Alleghany, Pa.

492,699. Electric Railway. Michelangelo Cattori, Rome, Italy.

492,681. Armature for Dynamo-electric Machines. George Hoare, Newark, N. J.

492,689. Relay. Jacob W. Lattig, Easton, Pa.

492,694. Electric Alarm for Hotels. John McMurrow, Jr., Philadelphia, Pa.

492,711. Ore Amalgamator. John E. Chaster, Shawlands, N. J.

492,713. Wending Metals Electrically. Charles L. Coffin, Detroit, Mich.

492,757. Rheostat Plate. Charles E. Carpenter, Bridgeport, Conn.

492,758. Rheostat Plate. Charles E. Carpenter, Bridgeport, Conn.

492,767. Production of Artificial Crystalline Carbonaceous Materials. Edward G. Acheson, Monongahela City, Pa.

EUGENE F. PHILLIPS, Prest. W. A. HATHAWAY, Treas. W. H. SAWYER, Sec'y.

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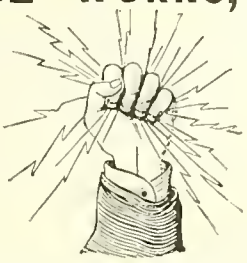

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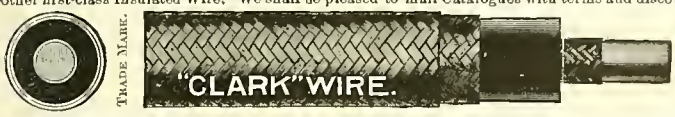

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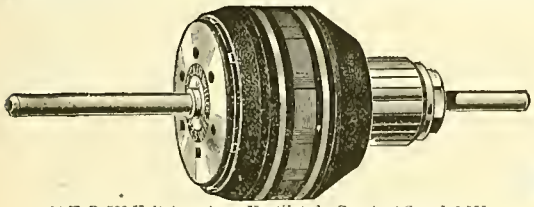

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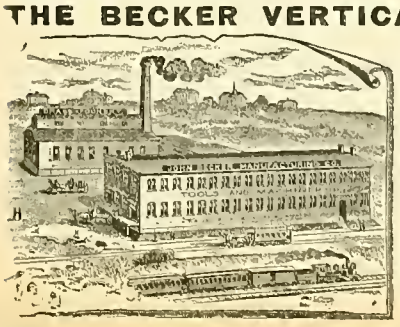

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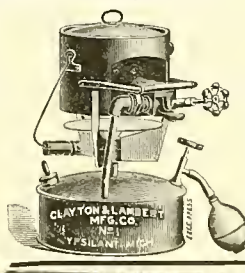

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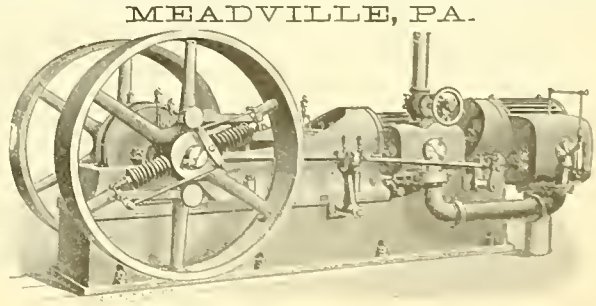

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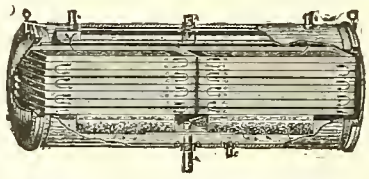

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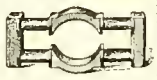

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Receiver's Sale of Street Railway

At Milwaukee, Wisconsin.

Notice is hereby given that in pursuance of an order of the Circuit Court of Milwaukee County, Wisconsin, I will, on the 30th day of June A. D. 1893, at eleven o'clock in the forenoon of said day, at the south door of the Court House in the city and county of Milwaukee, Wisconsin, offer for sale and sell at public auction as an entirety, the street railway of the Milwaukee Electric Railway Company in said city of Milwaukee, with all the franchises and rights and privileges of said railway company for the operation and maintenance of the same, and all the property of said corporation used in or in connection with, or essential to the exercise of its said franchises.

Said railway property and franchises consist of about 6½ miles of double track, being about 13 miles of single track, in said city of Milwaukee, with all the poles, wires, cables, trucks, ties, stringers, fixtures and appliances composing or used in connection with said tracks or said railway, with franchises, privileges and rights derived from ordinances of the common council of the city of Milwaukee to maintain and operate said road; also sundry parcels of real estate in said city, with car barns and power house thereon; also the engines, boilers, machinery and rolling stock and supplies of said road.

The terms of such sale are cash.

The said street railway will be sold free of all liens and encumbrances except judgments of foreclosure and sales aggregating $21,193.56, with interest from the 22d day of November, 1892, at 7 per cent. on $1,259.60 thereof, and at 6 per cent. per annum on the remainder. Said judgments of foreclosure covering the said specific parcels of real estate.

Dated Milwaukee, Wis., Feb. 27, 1893.

G. J. MELMS,
Receiver of the Milwaukee Electric Railway Company.

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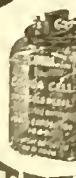

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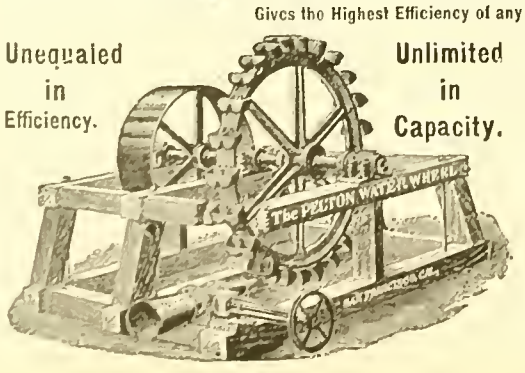

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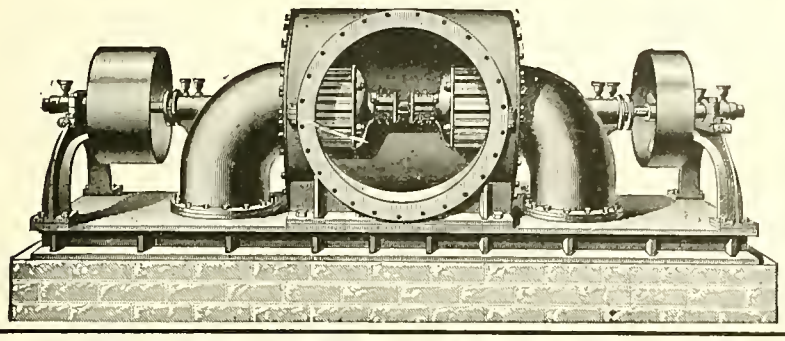

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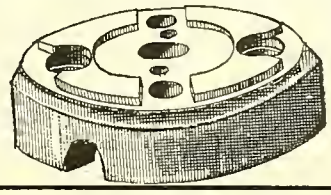

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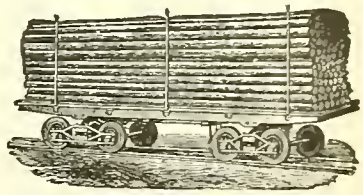

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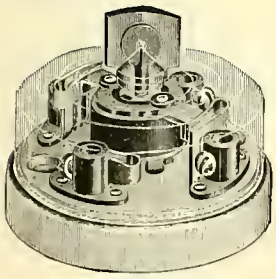

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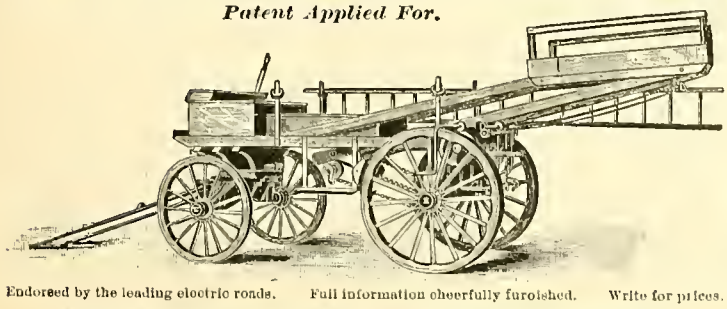

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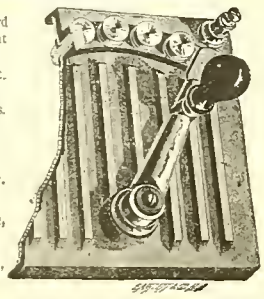

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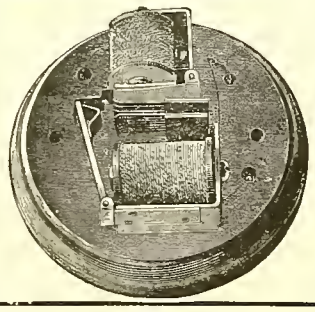

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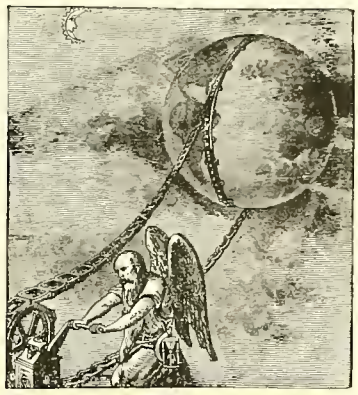

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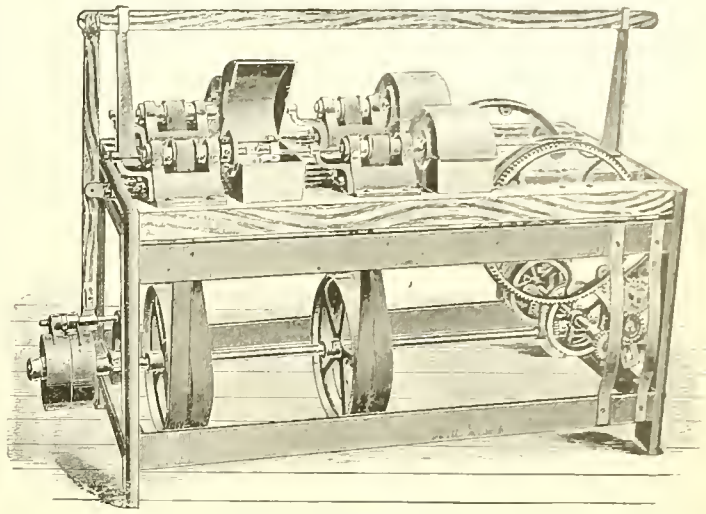

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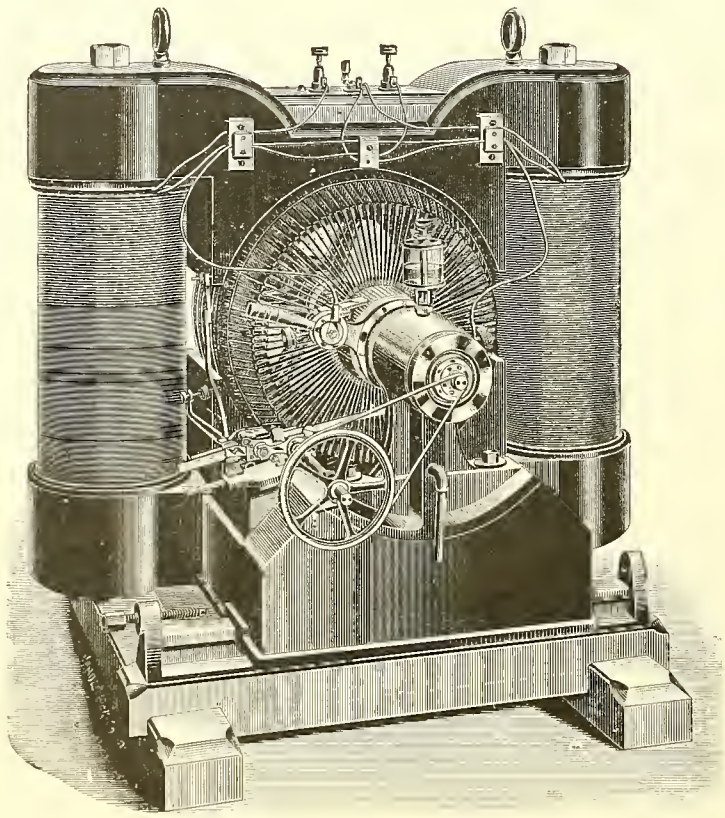

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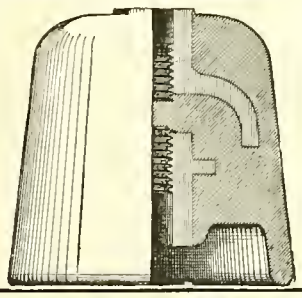

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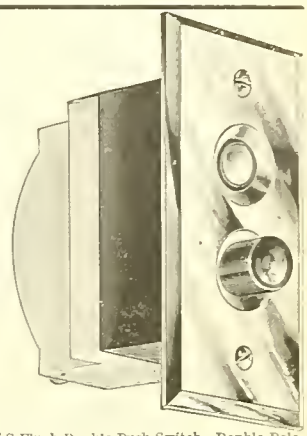

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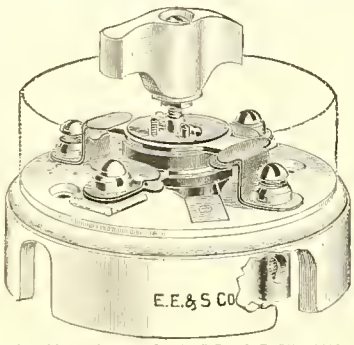

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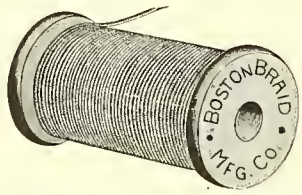

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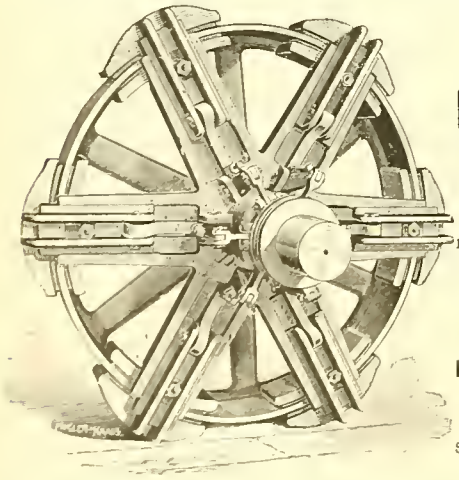

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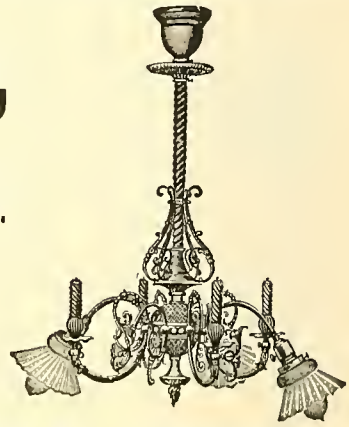

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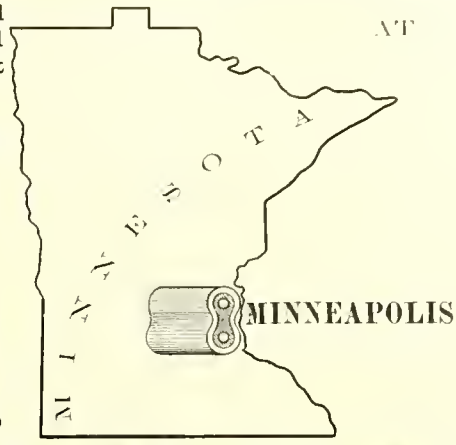

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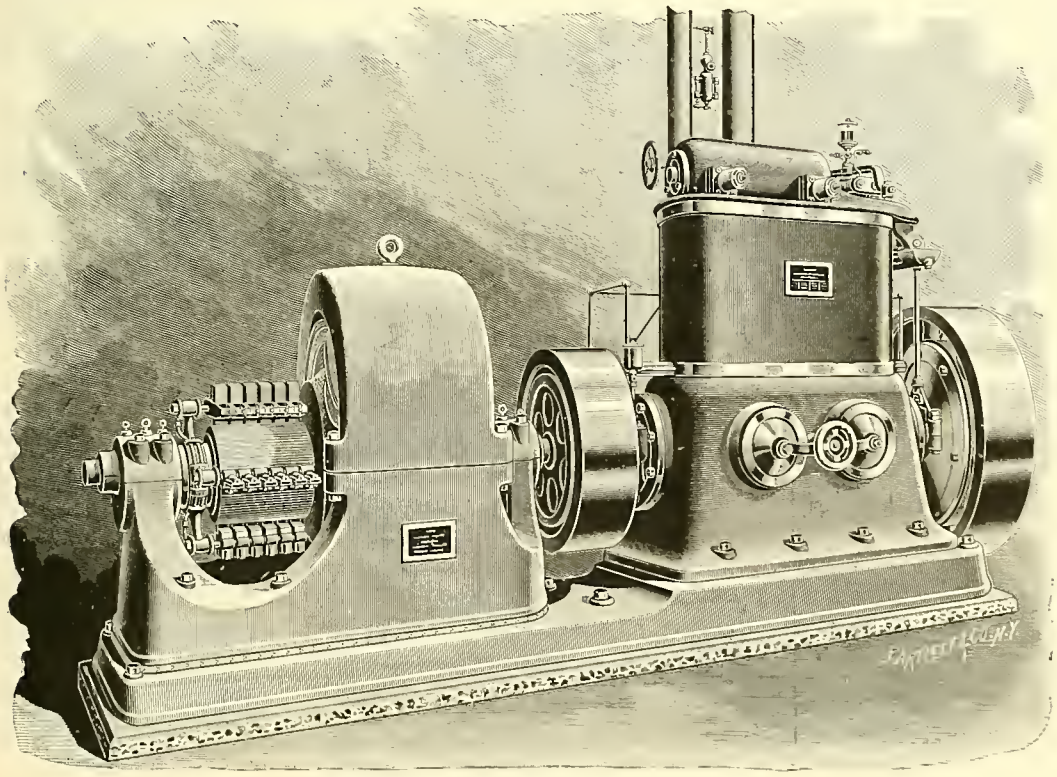

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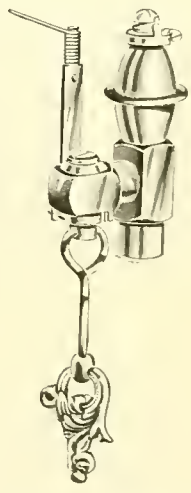

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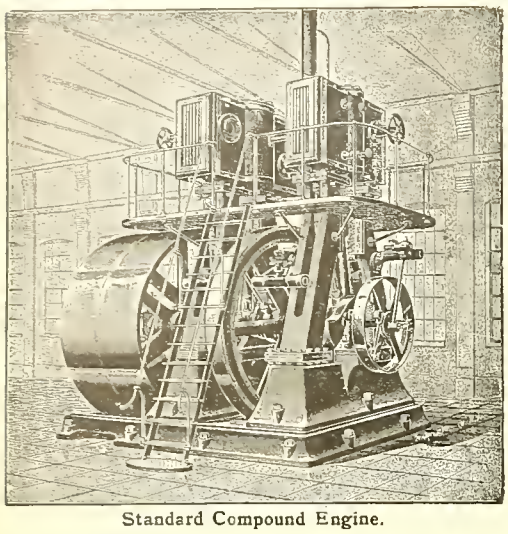

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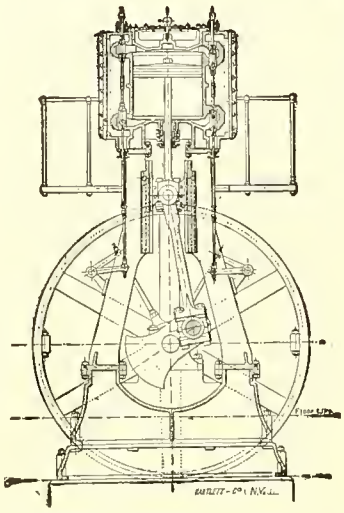

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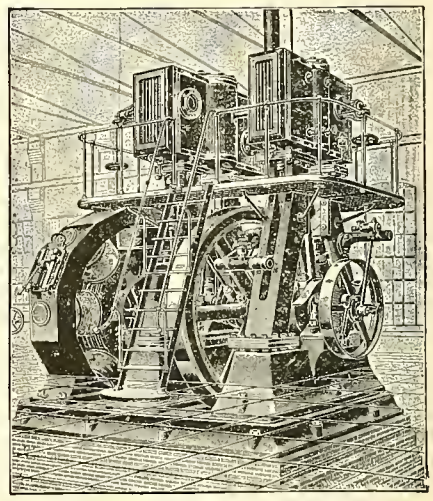

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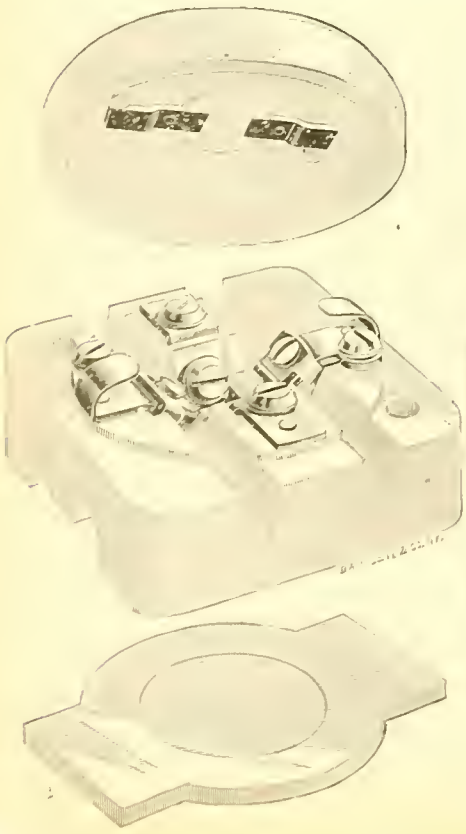

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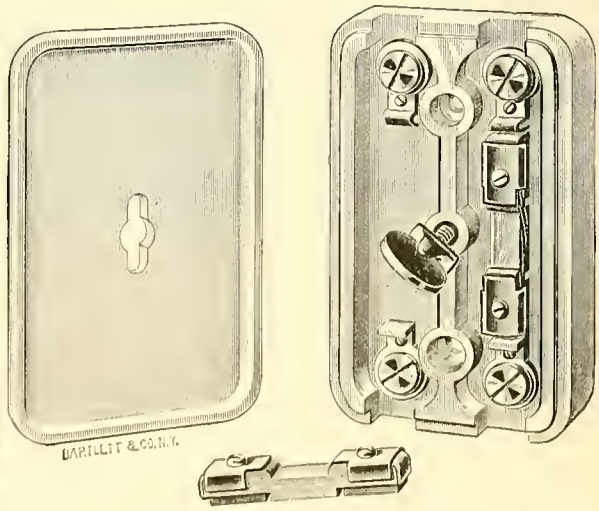

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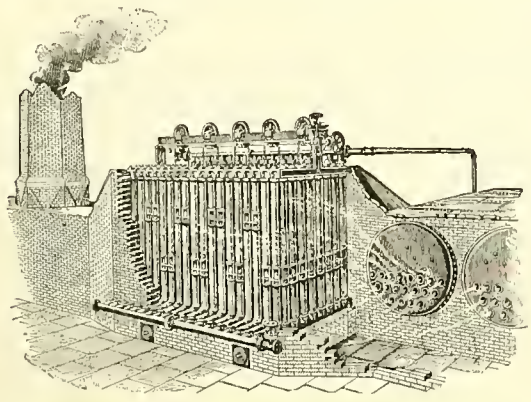

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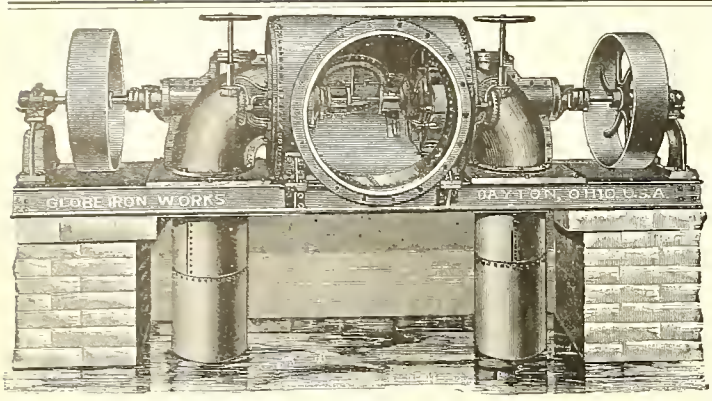

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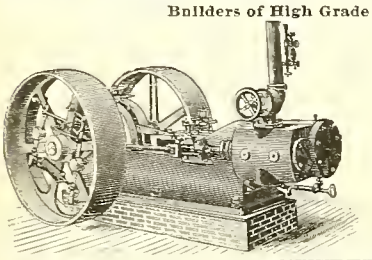

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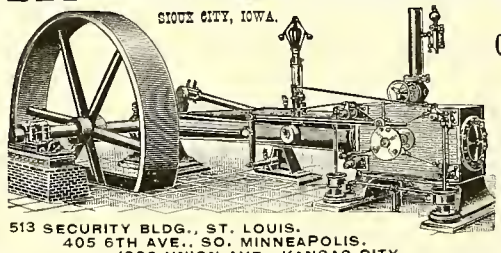

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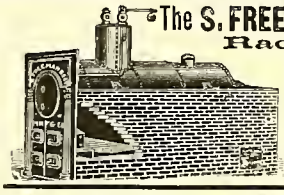

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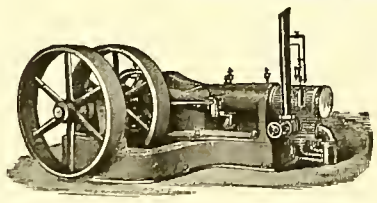

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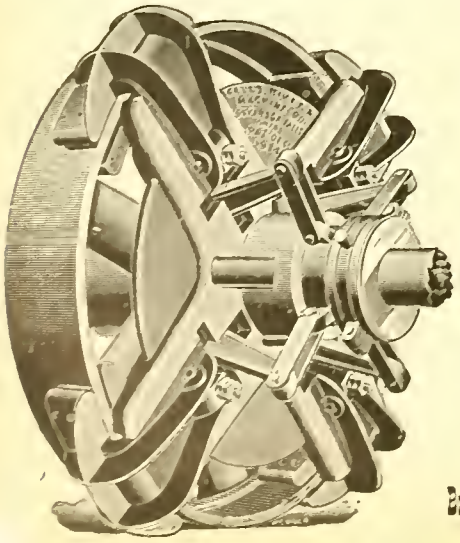

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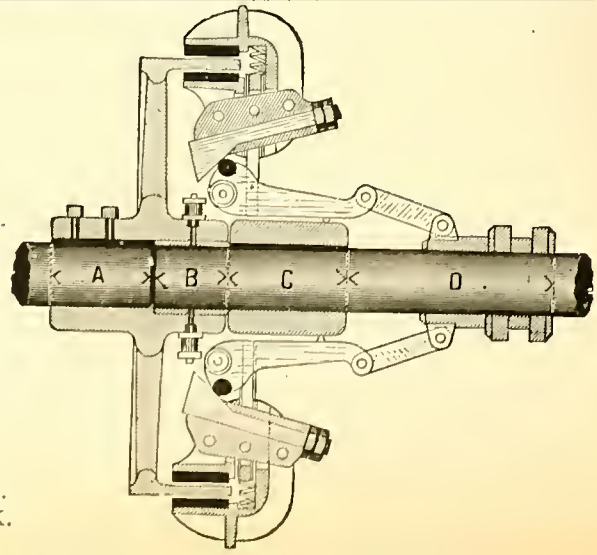

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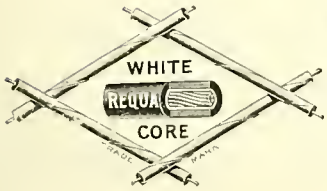

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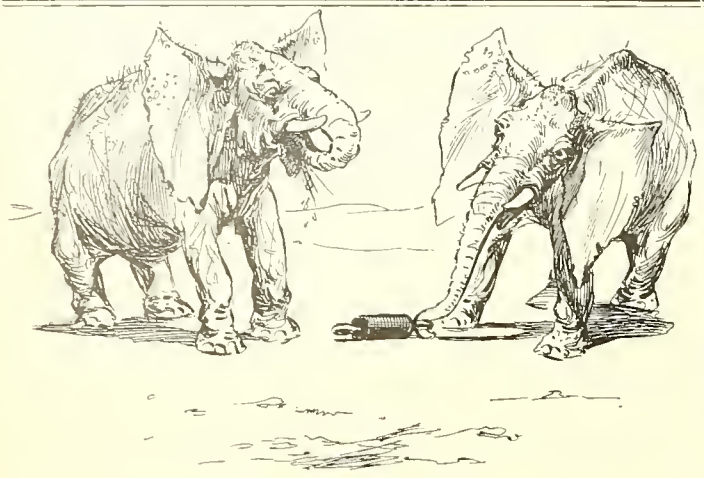
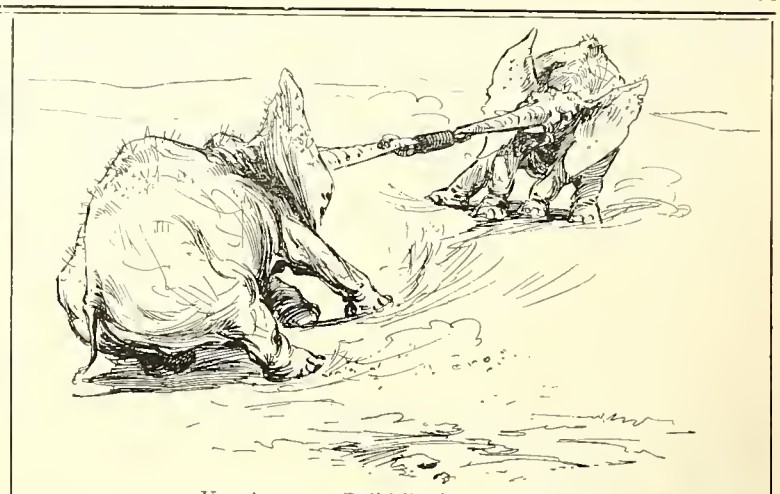
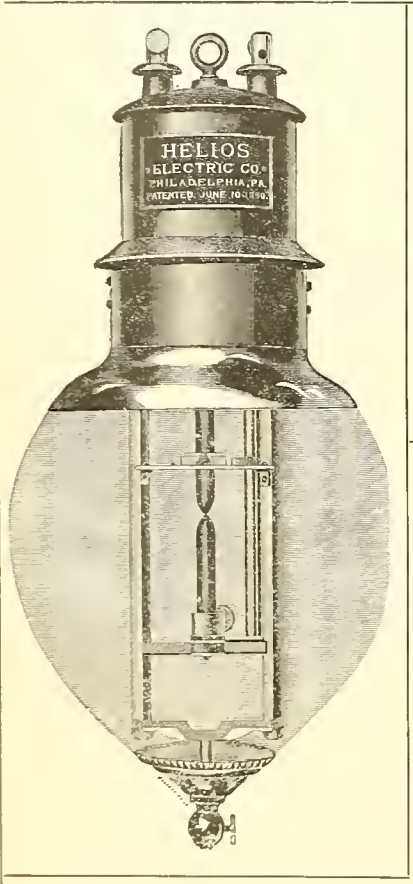
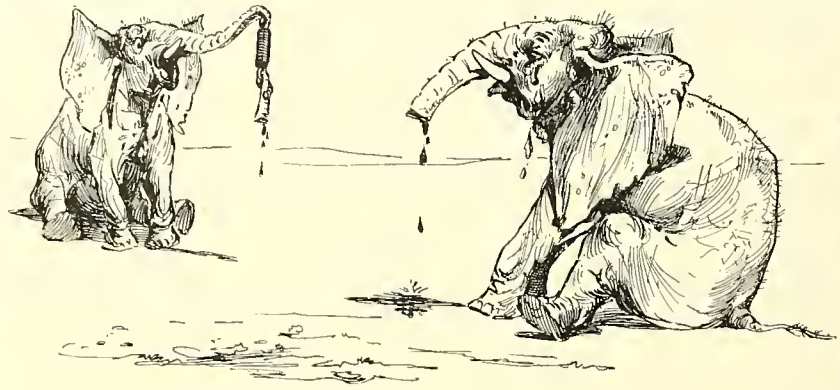


IV. Bim: "Hold on till I wet my whistle."



V. Abdul: "Pull-l!" Bim— "Pull-l-l!'





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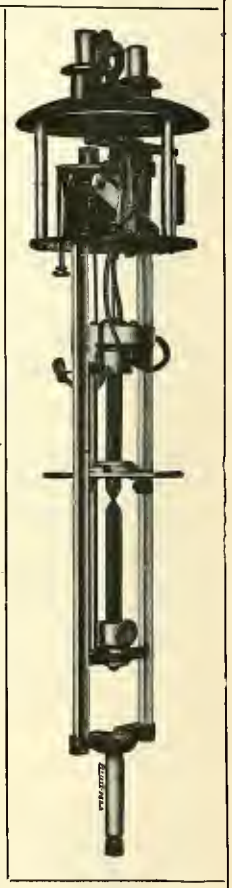

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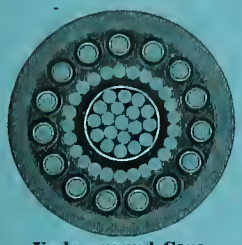
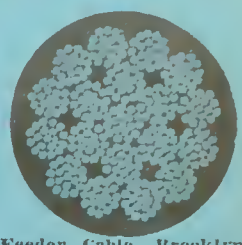
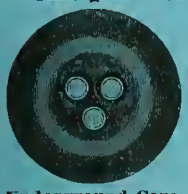
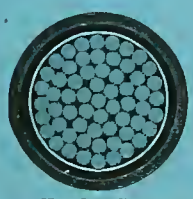

Underground Core.


Feeder Cable, Brooklyn Edison Electric Light Co.


Underground Core, N. J. Central R. R.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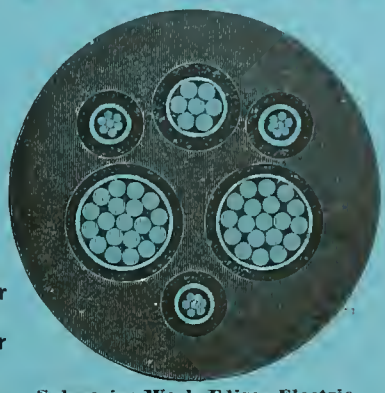
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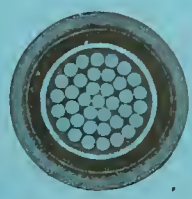
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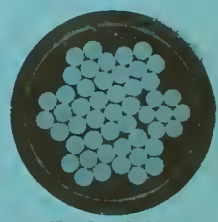
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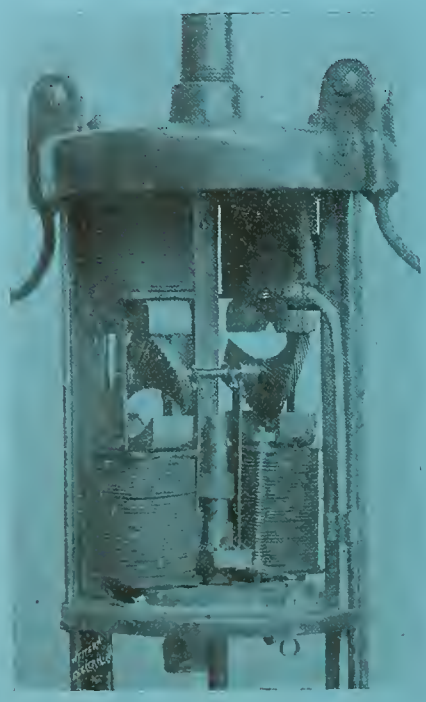

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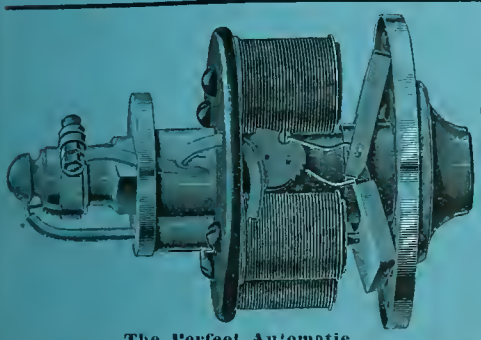

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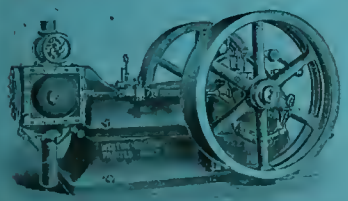

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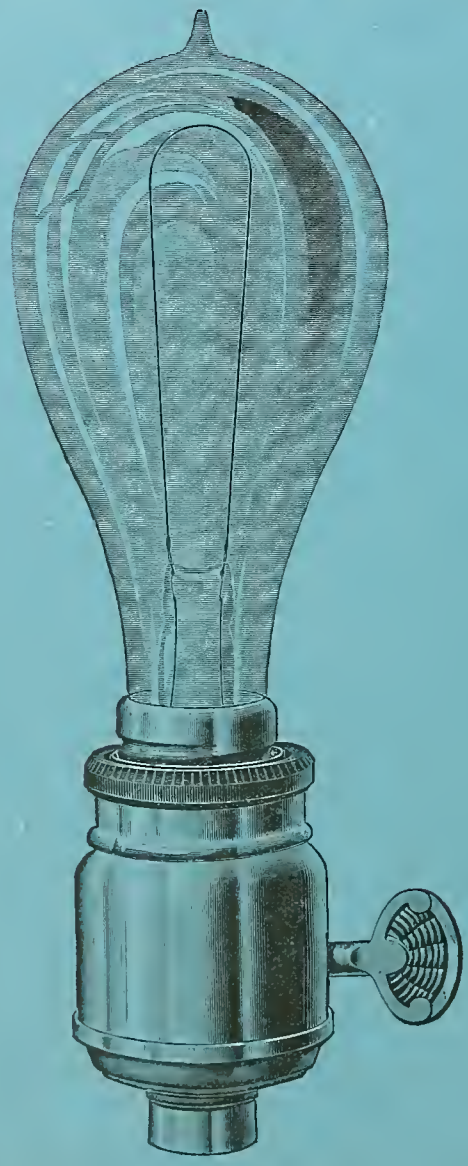

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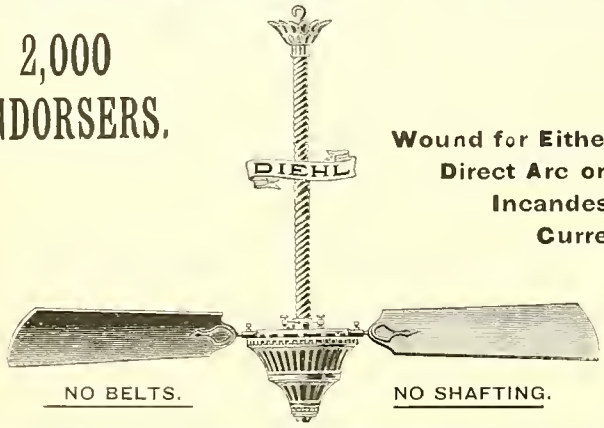

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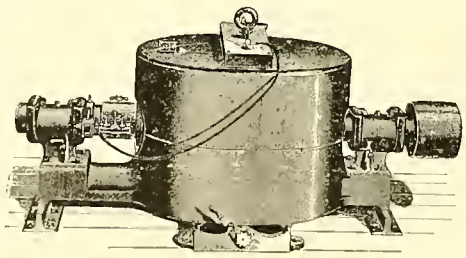

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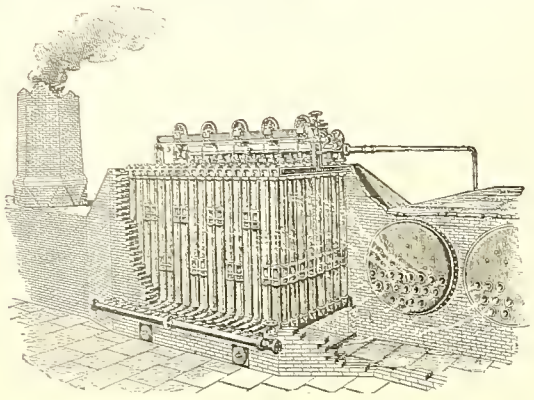

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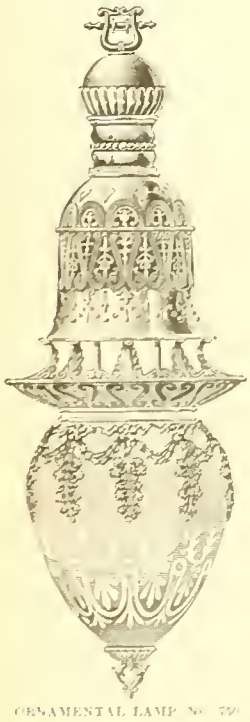

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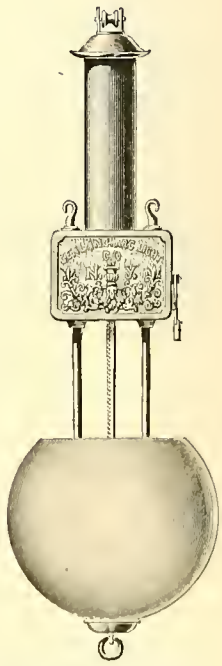

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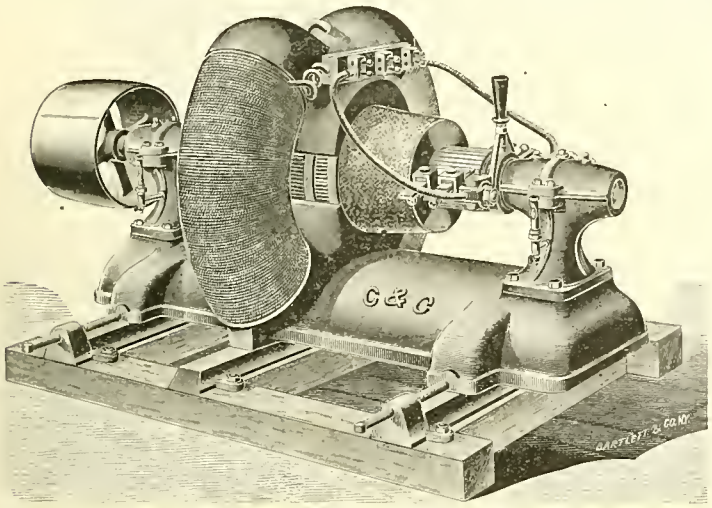

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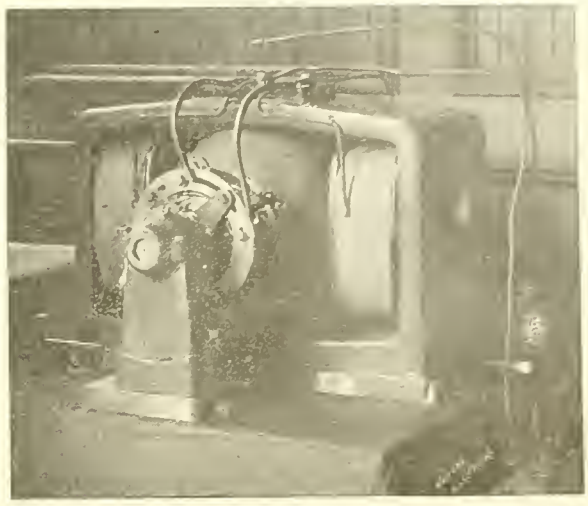

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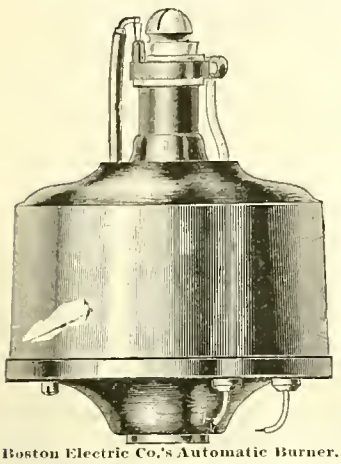

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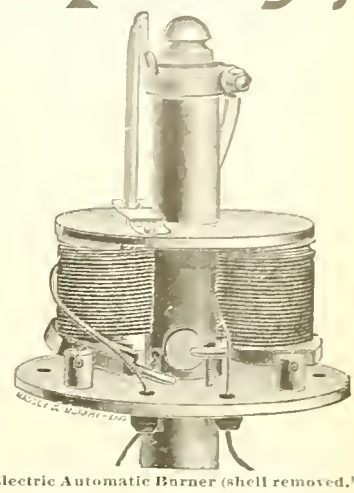

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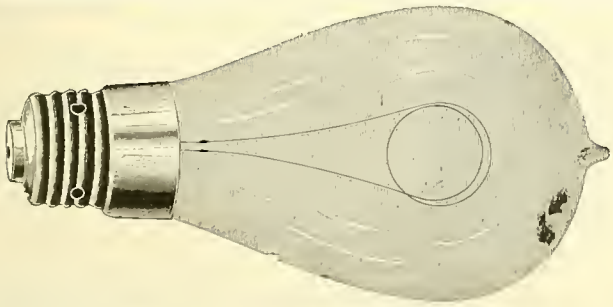

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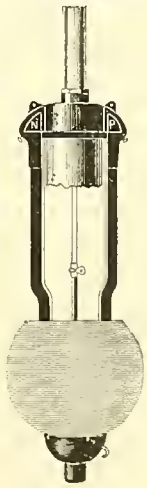

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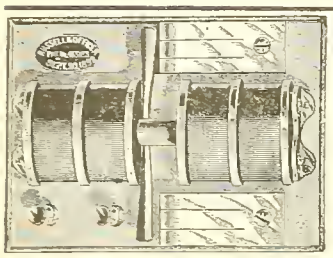

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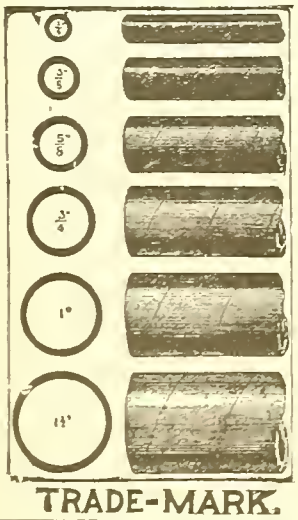

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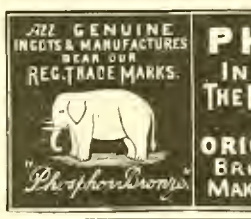

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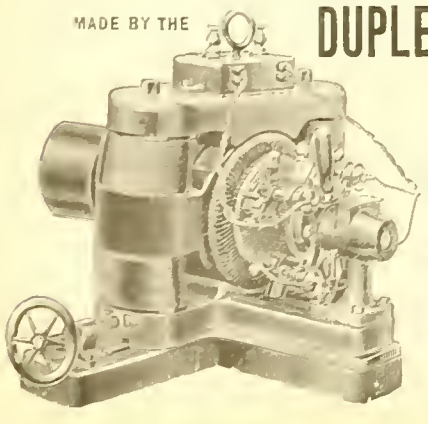

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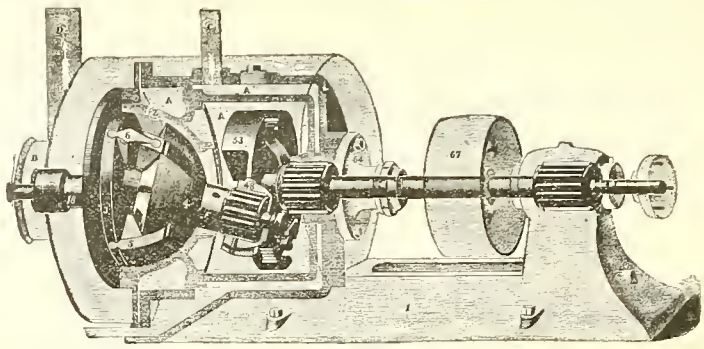

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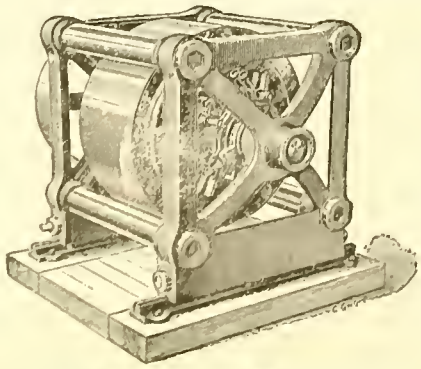

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Western Electrician

EVERY SATURDAY.

Vol. XII. CHICAGO, MARCH 18, 1893. No 11

Gen. Thomas T. Eckert.

On March 8th the directors of the Western Union Telegraph company, at their quarterly meeting in New York, elected Gen. Thomas T. Eckert president of the company to succeed Dr. Norvin Green, deceased. Gen. Eckert has been first vice president and general manager of the company for the last twelve years, and his promotion was generally expected.

If long experience be accepted as a qualification for the elevated position to which Gen. Eckert has been called, the new president is peculiarly well fitted to guide the destinies of the Western Union company, as no man in the United States can point to a more prominent career in connection with the telegraphic interests of the country. Thomas T. Eckert was born in St. Clairsville, O., April 23, 1825. He was among the first to learn telegraphy, and in 1849, when he was appointed postmaster at Wooster, O., he was also the telegraph operator there. At this time J. H. Wade of Cleveland was building telegraph lines westward, and, being attracted by Mr. Eckert's vigor and industry, he made the young operator superintendent of the "Union Telegraph Lines," which were, about 1852, extended from Pittsburg to Chicago by way of the Fort Wayne and Chicago railroad. Mr. Wade soon afterward became identified with the newly formed Western Union Telegraph company, and, one by one, his lines were absorbed by the new company. By this amalgamation Superintendent Eckert first entered the service of the great corporation of which he has just been elected president. In 1859, however, he left the telegraph business to superintend the affairs of a gold mining company in Montgomery county, N. C., leaving behind him a reputation for energy, good judgment and hard work.

When the war broke out in 1861 Mr. Eckert came north and located in Cincinnati, but he was soon called to Washington and placed in charge of the military telegraphs in the Department of the Potomac, with the rank of captain and assistant quartermaster. In 1862 he acompanied Gen. McClellan to the Peninsula, and in September of the same year he was recalled to Washington to establish the military telegraph headquarters at the war department, and was promoted to the rank of major. In this service Major Eckert distinguished himself. He sustained intimate relations with President Lincoln and Mr. Stanton, the war secretary, enjoying the complete confidence and high esteem of both these great men. As an evidence of this it may be mentioned that in January, 1865, he was appointed to meet the leaders of the confederacy at City Point, a delicate mission which he executed with marked intelligence and discretion. In 1864 Major Eckert was breveted lieutenant-colonel and not long after he was invested with the rank of brigadier-general. About the same time he was appointed assistant secretary of war, a position he held until August, 1866, when he resigned to accept the office of general superintendent of the eastern division of the Western Union company. In his five years' connection with the army and war department Gen. Eckert served his country well and was the most conspicuous figure in the indispensable military telegraph service.

From 1866 to 1875 Gen. Eckert performed the duties of superintendent of the eastern division of the Western Union. He was not entirely satisfied with his position, however, and in the latter year he was made president of the Atlantic & Pacific Telegraph company, which was dominated by Jay Gould, who was ever the steadfast friend of Gen. Eckert, and which later came under the control of the Western Union. Mr. Gould was dissatisfied with the administration of the Western Union, however, and in 1879 he and others organized the American Union Telegraph company as a competitor to the Western Union. Gen. Eckert became president of the new company on January 1, 1880, and devoted himself with great energy to the work of building it up. At the close of his first year's administration the company showed 2,000 offices and 50,000 miles of wire. This was the most formidable opposition the Western Union company had yet encountered, and the directors became alarmed. A conference of the leading men of the two companies was arranged, and, after much negotiation, consolidation was perfected early in 1881. From this time until his death Jay Gould practically controlled the company. After the consolidation Dr. Green was retained as president, but by an executive order dated February 12, 1881, Gen. Eckert was made first vice-president and general manager and placed in charge of the construction, equipment, maintenance and operation of the lines and offices. This position he retained until elected president.

GEN. THOMAS T. ECKERT.

Gen. Eckert is a strong man, physically and mentally, as may be inferred from the portrait presented on this page, which is a reproduction of a late photograph. He is a strict disciplinarian and insists on prompt obedience and respect from subordinates. Nevertheless, he is a man of kindly heart and makes and retains friends. His executive ability is conspicuous, and it cannot be doubted that he will conduct the affairs of the company with ability and success. The appointment has been well received throughout the country as the best and most natural one that could be made.

Chicago-North Shore Electric Railway.

Work has been begun for an electric railway to connect Chicago and Evanston, which the Chicago-North Shore Street Railway company is building. This road will be one of the most important of Chicago's suburban electric railways. The line starts at Graceland avenue, and runs northwest on Evanston avenue to the city limits, thence it follows City Limit street to Chicago avenue in Rogers Park; here it takes a northerly direction through Rogers Park and Evanston to Dempster street, where it turns to the west and runs to Sherman avenue; thence north on Sherman avenue to North Evanston, terminating at Emerson avenue for the present. It is expected that the road will soon be extended to the south from Graceland avenue to Diversey avenue, where a connection with the Yerkes cable will be made. In all, the road will be about nine miles long. For two and a half miles on Evanston avenue a center pole construction will be used, while the balance of the overhead wiring is supported by iron poles at the side of the street. The feeders are all of No. 0000 and No. 000 copper wire, calculated for a five per cent. drop for the end of the lines. Standard girder rails, weighing 85 pounds to the yard, will be used. The American Railway Construction company of Chicago, successor to Wright & Meysenburg, has the contract for the track construction. The rolling stock will consist of Pullman cars. The power house is located on Evanston avenue, near Ardmore avenue. It is a handsome two-story building, with a frontage of 100 feet and a depth of 230 feet. Here the offices of the company will be located, and a portion of the building will also be utilized as a car barn at first. The General Electric company is supplying the electrical equipment, and B. J. Arnold is the mechanical and electrical engineer. Three 250 horse power Heine water tube boilers will furnish steam at the start, although the station is designed to have an ultimate capacity of 3 000 horse power. Power will be furnished by one 800 horse power double Wheelock engine, which will drive, by rope transmission, a jack shaft, to which will be coupled directly two 300 kilowatt multipolar generators of the General Electric type. A steel stack 145 feet high, and with an inside diameter of eight feet, will be a feature of the plant. The engines will be installed by the California Engineering company and McArthur Bros. are now building the foundations.

Municipal Control of Electrical Enterprises.

Municipal control of electric lighting was the subject of the recent prize debate at the University of Wisconsin. The debate was between the Athenæ and the Philomathia. The discussion included electric railways as well as electric lighting, limiting both to cities having a population of 25,000 or more. Hubert E. Page, E. R. Stevens and J. M. Johnston of Athenæ advocated municipal ownership, and the opposition was represented by J. A. Pratt, J. B. Pollock and J. A Webster. The debaters had devoted nine months to preparation for the discussion, and the arguments were excellent. The judges were State Senator Neal Brown of Wausau, Rev. E. G. Updike and President C. K. Adams of Madison. Prof. Richard T. Ely, the famous writer on social economy, was very much interested in the debate, and he will publish the results of the labors of the debaters in a volume which will contain the arguments in full and an appendix.

The Atlantic City, N. J., Electric Light & Power company will build an electric railroad along the beach, having issued $200,000 of bonds for that purpose.

R. H. Pierce, Electrical Engineer at the World's Fair.

By the resignation of Frederick Sargent, R. H. Pierce, who has been the assistant electrical engineer for some time, is made the most conspicuous figure in the electrical department of the construction and maintenance work of the World's Fair. Mr. Pierce is well qualified by long experience to fill the position, and he has a host of friends in Chicago and elsewhere who will wish him all possible success.

Richard H. Pierce is a New Englander, having first seen the light in Woonsocket, R. I., November 20, 1860. He spent most of his boyhood and youth in and near Boston, where he fitted himself for Yale College, from which he graduated in 1882. He determined to adopt electrical engineering as a profession, and took a three years' course at the Massachusetts Institute of Technology. Although this was only a little over ten years ago, the importance of scientific instruction in electrical work was just beginning

R. H. PIERCE.

to be recognized, and it is an interesting fact that Mr. Pierce was one of the two members of the first class in electrical engineering ever graduated from the Boston school, the other being Frank Pickernell. With this thorough preparation Mr. Pierce, after his graduation in 1885, entered the Edison station at Brockton, Mass., which was the second city in the country to have underground incandescent circuits, New York being the first. Many of the most noted engineers of the Edison company were consulted in relation to the underground work for this station, and young Pierce found the experience very valuable.

In March, 1886, Mr. Pierce came to Chicago, and for the next five years he was actively connected with the Edison interests in this city, being associated for much of the time with H. Ward Leonard. He began with the Western Edison Electric Light company and remained through all the changes until the Edison General Electric company was formed. He served both in technical and commercial capacities, gaining a wide experience. At one time he was agent for Wisconsin and Michigan, with an office in Detroit. In March, 1891, Mr. Pierce became associated with the Electrical Engineering company of Chicago, of which he was one of the founders. In November of the same year, however, he accepted an offer from Mr. Sargent to become assistant electrical engineer for the construction department of the World's Fair, and this position he retained until about three weeks ago, when he was made electrical engineer.

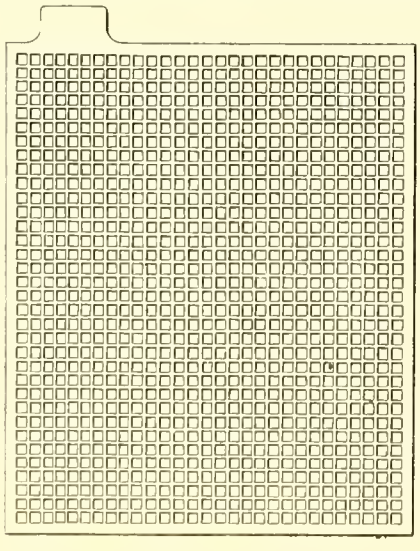
Mr. Pierce possesses a philosophical temperament, well calculated to withstand the wear and tear of the difficult duties he will be called upon to fulfil. He has much inventive ability and is quick to see the way out of an emergency. He is popular and is sure to make a good record in his new position.

Treatment of Secondary Battery Plates.

Inasmuch as one of the great objections to storage batteries is the first cost of the equipment, manufacturers will undoubtedly examine with interest the claims of Robert Mackay Lloyd of New York, who claims to have discovered a method by which cells may be cheaply and rapidly produced, and at the same time compare favorably with those now on the market in point of efficiency. This invention may be applied to the familiar form of plate represented in the cut. The plate is subjected to the action of a solution, by means of which it is honeycombed, and active material, or material to become active, is chemically deposited. This solution is, in the first instance, acid, but as the treatment goes on it becomes and remains alkaline. It has been found that a solution of dilute nitric acid, to which a small percentage of carbonate of potash has been added, or other alkali, is most effective. The plate being immersed, the solution is heated or even boiled and the surface of the plate becomes honeycombed or pitted. The time this plate is subjected to the boiling process depends upon various conditions, as the size and character of the plate, and the strength of the solution. During this process there is deposited chemically on the plate active material, or material to become active, such as lead or some of its combinations, in the state of minute subdivision, filling the honeycombings of the plate and covering its surface. After the solution becomes alkaline, and after sufficient active material is deposited on the plate, it is withdrawn and dried, and is then submitted to the "forming" action in the usual way.

Electricity at the World's Fair.

Frederick Sargent has retired from the service of the World's Columbian Exposition company. He wrote his resignation on March 5th, and it was accepted two days later. Mr. Sargent was appointed electrical engineer of the bureau of construction two years ago this month on the recommendation of Prof. Barrett and the Chicago Electric club. Later in the same year Mr. Slocum, the mechanical engineer, resigned, and Mr. Sargent was chosen to fulfill the duties of this position in addition to those that had formerly devolved upon him, his title being mechanical and electrical engineer. As the engineering work grew with the progress of construction at Jackson Park, Mr. Sargent was provided with an assistant for each of the branches in his charge, and each of these officers, in turn, supervised the work of a number of heads of sub-departments. A building was erected for the office force of the mechanical and electrical engineering department, and the work was systematized. About three weeks ago there was another change by which Mr. Sargent was made general manager of the mechanical and electrical engineering department, with an office at 214 Service building, near Chief Burnham, who, as everybody knows, has general charge of the construction work for the local company. At the same time R. H. Pierce was given the title of electrical engineer and Charles F. Foster was made mechanical engineer. Previously these gentlemen were known as assistant electrical



TREATMENT OF SECONDARY BATTERY PLATES.

engineer and assistant mechanical engineer respectively. Then came the resignation of Mr. Sargent. It is probable that the office of general manager of this department, which was created for Mr. Sargent, will remain vacant, the direction of the engineering work resting in Messrs. Pierce and Foster. A portrait and brief sketch of the former are given in another column. Mr. Foster is an experienced and competent engineer who was for many years connected with the Heine Safety Boiler company of St. Louis.

To enter fully into the causes that led to Mr. Sargent's resignation would necessitate a re statement of the peculiar double-barreled administration which has precluded efficient organization at the World's Fair and to which, largely, may be ascribed the wretched squabbles that have made the disinterested friends of the exposition sick at heart. There seems to be no supreme authority, and there has always been a struggle for power between the representatives of the national commission and the local company. In Mr. Sargent's case, however, it is but an act of simple justice to state that the electrical fraternity should understand that his retirement was not caused by any distrust of his ability as an engineer, as has been intimated in some of the daily papers of Chicago. In laying out steam and electric plants Mr. Sargent has few superiors in this country, and his excellent work at the World's Fair has received cordial recognition by all connected with the enterprise who are competent to express an opinion. Defects of organization and red-tape regulations have caused friction between the head of the mechanical and electrical engineering department and officers in charge of the general construction work, but no one about the exposition ques-

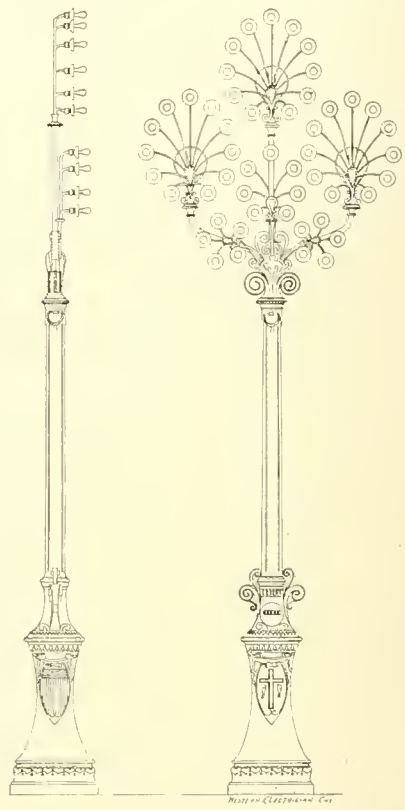


FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.

tions Mr. Sargent's complete ability as an engineer to fill the position. Much of the trouble was caused by the controversy over the service exhibit of the Stirling company, in which Mr. Sargent took a position against this company, which was subsequently overruled by the council of administration. The Babcock & Wilcox company, in whose favor Mr. Sargent had decided, took the matter into the courts and was defeated. The affair thus attracted much attention, and it is believed that it had much to do with Mr. Sargent's resignation. There were also many other annoyances and interferences in the conduct of the department, and when to these were added business and family reasons, Mr. Sargent evidently came to the conclusion that the sacrifice involved in staying with the exposition was too great. There is no question but that Mr. Sargent has devoted his best thought and energy to the World's Fair for the last two years, and if he has made errors of judgment in the trying position in which he has been placed his motive has ever been the good of the fair, coupled with an earnest endeavor to have the service plant ready on time. Personally he is well liked, and it speaks well for him that every man under him sincerely regrets his departure.

Much attention is attracted by the size of the parts of the big Westinghouse alternators that are now on the grounds. Each armature weighs 21 tons, and is a load for a flat car. An idea of the size of the armature and the manner of shipping can be gained by a glance at Fig 1, which shows one—that for dynamo No. 7—as received in Jackson Park. The projection on the right contains the end of the shaft. The armature was first incased in galvanized iron and then boxed up as shown.

There will probably be seven large search lights at the World's Fair. Three of these will be sent over by Schuckert & Co. of Germany, and the diameters of the projectors will be respectively six, four and three feet. Negotiations are now in progress for the furnishing of the remaining lamps by the General Electric company and other manufacturers. Two of the search lights will be located on the

northeast and northwest pavilions of the manufactures building, two on the northeast and southeast pavilions of the administration building, one on the roof of the music hall and one on the casino. The remaining lamp has not yet been located, although the German building has been suggested.

Probably the handsomest incandescent light fixture at the World's Fair is that illustrated in Fig. 2, which shows a front and side view of one of the 50 light standards to be placed in the administration building. There will be eight of these standards, one on either side of each of the four grand entrances. They will be 19 feet high and will present an imposing appearance. The metal work will be all of oxidized copper, which gives a very rich effect. E. Baggot of Chicago is making the fixtures, and also eight 25 light brackets and fifty-six 7 light standards of similar design for the same building. The designs were made by Mr. Sarnier of the World's Fair staff, and it will be noticed that the pedestals are decorated with the coats of-arms of Ferdinand and Isabella and of the United States. The work is being done under the supervision of James A. Lounsbury, supervisor of incandescent lighting for the electrical engineering department of the World's Fair, and A. R. Hildreth secured the contract for Mr. Baggot.

Secretary Hirst of the installation bureau has received an application describing what are said to be the smallest steam engine and dynamo models in existence. S. A. Asquith of 65 Fifth avenue, Pittsburg, is the maker, and he desires to exhibit at the World's Fair. According to the description filed, the engine is of 14 karat gold, with a cylinder 6-100 inch in diameter and 6-100 inch piston stroke. The builder says that two such engines could be placed in a 22 caliber cartridge. The engine and dynamo can be packed together in a box 5 16 inch square. It took 13½ inches of silk covered wire to wind the field and armature.

It has finally been decided that the electricity building, as well as all others except the transportation, shall be painted white.

The differences between the exposition management and the wiremen have been amicably adjusted. The men are to receive 37½ cents an hour, but the union agrees that the company shall have the right to discharge those who are not considered expert workmen.

It is proposed to enable New Yorkers to listen to President Cleveland's address on opening the fair by placing a large funnel shaped receiver, connected with the long distance telephone line, near the stand at which he will speak. Some of the long distance wires will be run into the concert hall, where Theodore Thomas will preside, and those outside of Chicago who wish to hear the concerts can do so at a cost not much exceeding the entrance fee to the concert hall itself.

Electric Installations and Some Radical Changes in General Systems of Wiring.[1]

By Charles G. Armstrong.

It is not my intention this evening to enter into a general discussion of isolated electric installations but simply to point out common errors and suggest such remedies as would seem, in my judgement, to make a better plant. In planning a building it is true that the designing of the electric plant is generally left until the last. In my experience I have found it not an unusual thing to be called upon to design a plant, when upon receiving the plans I find that the architect has left room for the plumbers' pipes, has prepared excellent runways for drainage, has looked after his catch basins, has located his elevator pumps and given them plenty of room in the basement, has provided ample space for everything except the electric light plant. There are no raceways in the building, the space left for dynamos and engines is totally inadequate, the boiler capacity is about half what it ought to be, no place for storage of coal, and yet the most important feature of the entire building is light. It becomes necessary, of course, to at once make a claim for more space and provide raceways or some substitute therefor. Having obtained all the space possible the next item that confronts the designing engineer is how to lay out his plant.

There is a plant on State street that it was my duty to inspect and report upon a little while ago where I found an arc and incandescent dynamo running in a separate room about 50 feet from the switch-board. The plant really consisted of two separate plants connected to one switch-board; the only redeeming feature about it was that there was only about an hour a day when both dynamos were running at the same time. This plant showed an insulation resistance of ten ohms to ground on the arc circuit and one twentieth of an ohm on the incandescent circuit.

In order that the proprietor and others casually inspecting the plant would have a good opinion of it, the highly ingenious electrician in charge had disconnected the ground wire so his plant always showed clear on the ground lamp. It is often very much easier to remove the evidence of a ground than to go to the trouble of removing the ground itself. It would undoubtedly be better to have electricians of less ingenuity and more honesty in cases of this kind.

One cause of a bad plant is lack of forethought on the part of the designer of the building, another is desire to diminish the first cost, and a third is often force of circumstances. A person may have an old building, and to put in an electric plant he may have to accept what he finds and make the best of it. For the first two faults there is no excuse, and even the latter can be remedied by a little study on the subject and a proper selection of dynamos and engines. There is a great need to-day of a small unit direct connected slow-speed dynamo to be used in such places as I have last mentioned, where plants are to be installed in old buildings and the space is very limited. Perhaps some of you will say, "if you specify such dynamos, I will furnish them," but from the fact that it would require from six months to a year to design and perfect these sizes I would not dare specify them.

Generally, when a man has concluded to put in an electric lighting plant he wants it as soon as he can get it, and although he takes six months or a year to make up his mind, he wants the plant put in at once. But if such dynamos were constructed and kept in stock as ordinary dynamos are, I have no doubt that you would find a good demand for them and they would be a matter of great convenience both to the designer and the owner of the plant.

I prefer to get dynamos as close together as possible. The only conditions to be considered are first, that they will not be reversed in polarity by proximity of like poles, and second that the armature of any machine can be removed without disturbing the other. A modification of this condition could be made where space is very limited by running the smaller machines in tandem, but as a general rule I do not favor this arrangement.

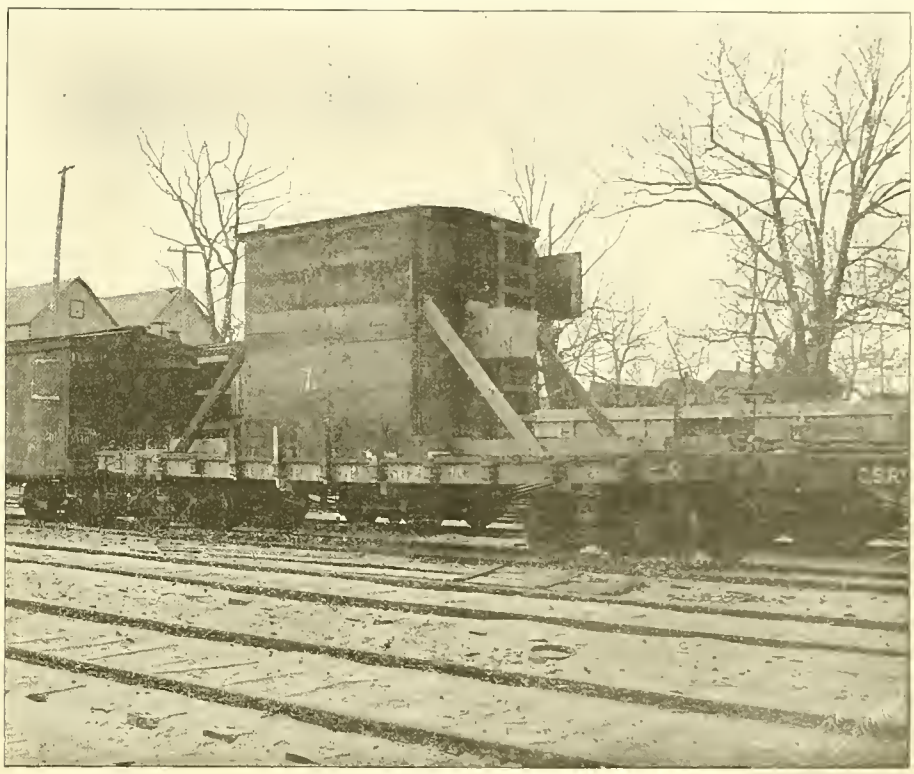


FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.

On the matter of foundations for dynamos I hold decided views. I like to have a good foundation under the dynamos, and while this is not as absolutely essential as a good foundation under the engines, yet a concrete or brick foundation in which the best quality of Portland cement has been used is very desirable thing. A strong wooden frame should be bolted to this foundation, and the bed plate of the dynamo would be bolted to the wooden frame. The wood should be previously soaked and thoroughly painted with insulating and water proof compound. This insulates the machines from ground. Some companies insist that their particular type of machine needs no foundation. I have handled almost every machine on the market and I have yet to find one that runs as well without a good foundation as it does with one.

Switch-boards are the next item of importance. The switch-board should be placed within six or eight feet of the commutator of the dynamo or as near that as possible; a greater distance is unnecessary and a closer proximity is not desirable. I believe that switch-boards should be made of marbleized slate or marble. I prefer marble and I use white marble in many cases, but between white and Tennessee marble, I prefer Tennessee from the fact that it is less easily stained. Slate is somewhat cheaper than marble but it absorbes moisture, which is a thing to avoid in switch-boards. If marbleized slate is used it should be thoroughly painted on the back to prevent absorption. There is one precaution which should be taken, however, in all marble switch-boards, that is in fastening instruments thereto. From the unyielding properties of either marble or slate it is advantageous to have a coil spring, and connections should be made after the manner shown in Fig. 1, otherwise the instruments will soon become loose by the jarring of the board. In no case should the wire connections to the instruments be so placed that it can jar loose, as there is great danger of arcing.

Where more than one dynamo is used, bus bars, I believe, are better than any other method of connection. If they are placed on the front of the board they must be polished and lacquered, and if fine effects are desired, they can be nickel plated. If placed on the back of the board, rough and unpolished copper bars can be used. Bus bars should be large, and of such capacity as not to heat perceptibly on the heaviest load. The object of this is to get a good connection. If they are made sufficiently large, connections can be tapped and screwed into them just as a bolt would screw into a nut. Where connections are made on the front of the board this method is not as desirable as the "stirrup," which is used pretty generally by first-class construction companies.

It should be the object of all designers of switch-boards to make the board as simple as possible. To avoid complications and yet have the board accomplish the purpose designed requires no little ingenuity on the part of the designer.

Electrical engineers and Philadelphia lawyers usually are not employed by owners to run plants. The salaries paid are so ridiculously small that in some cases the dynamo tenders are anything but what they should be in education or knowledge of the business. Often the engineer of the plant must also take care of the dynamos, although he admits that he knows nothing about them. The whole matter is a mystery to him except that he knows he must keep the brushes trimmed and perhaps polish off the commutator once in a while, and in order to perform his duty thoroughly he may perhaps use a file to do the polishing.

The great objection to connections being made on the rear of the board with bus bars, I find, is the liability of a great multiplicity of wires being run helter skelter across the back of the board, making the simplicity on the face of the board more than compensated for by the intricate connections on the back.

It often happens in very large buildings that the motor load amounts to quite a considerable part of the entire load. When such cases arise I believe in having a third bus bar on the board, which shall be used for motor connections. This applies only, of course, to such plants as have two or more dynamos. Where motor connections are used it is desirable to have an ampere meter to measure the amount of current used on the motors. This ampere meter should be "dead beat," and should have a range equal to all the motors in the installation. A careful attendant would know if his motors got into trouble or blow a fuse, and could also tell how the different loads were being handled throughout the building. This applies especially to cases where electric elevators are being operated from the same plant as the lights. As to other meters on this board I would prefer the non-polarized type, from the fact that they are less liable to get out of calibration. There is one slight disadvantage, perhaps, and that is if a machine should get to running as a motor an attendant might not as quickly understand it; but it is seldom indeed, that this occurs, and where it does the operator ought to know that the belt is pulling the wrong way.

Dynamo switches should be made double throw, one connection being onto the bus bars in such a manner that any or all dynamos can be thrown on the motor circuit. By closing a switch the motor circuit is placed in multiple with the lighting circuit. By opening this switch and throwing

1. Read before the Chicago Electric Club, February 20, 1893.

down a dynamo switch any dynamo is connected to the motor circuit.

Recently I was called upon to solve a problem in connection with the Schiller theater in this city, where the owners expected to take current from the Chicago Edison company's mains. As you are well aware the rules of the Edison company prevent the operation of 110 volt motors upon their lines from the liability of throwing the lines out of balance. They require that motors operating on their lines should be 220 volts. We were not using the three wire system in the building, and it was necessary to construct a switch-board in such a way that 220 volts could be obtained on the motor circuit from our own plant as well as from the mains of the Chicago Edison company. In order to accomplish this the dynamo switches are arranged

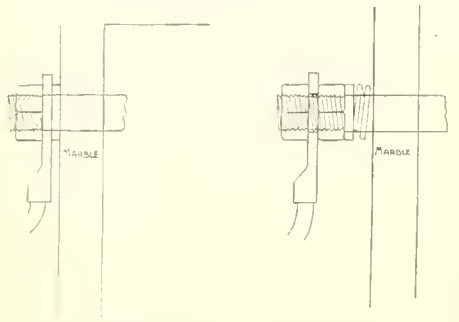


FIG. 1. ELECTRIC INSTALLATIONS AND SOME RADICAL CHANGES IN GENERAL SYSTEMS OF WIRING.

to throw any dynamo in series with the others by a simple movement of the switch. The motors throughout the building are used to operate ventilating fans, and therefore can be operated at 220 volts or 110 volts according to the amount of ventilation desired. In addition to this a small rheostat placed in the field of each motor allows us to get any variation of speed desired with scarcely any waste of current. I may say in this connection that the use of ventilating fans is becoming more and more appreciated by architects and owners, and this method of varying speed is a very advantageous and economical way of regulating ventilation. In this plant the switch-board is placed in the middle of the room, completely boxed, is very close to the commutator, and is convenient in operation [1]

There is nothing more important in an installation, outside of dynamos, than wire. Use always the best wire. In making tests upon wire I do not believe in soaking it in chloroform, naphtha, sweet spirits of nitre, or any other absurd method. In the ordinary course of events wire is not subject to the influence of any of the substances named. The greatest enemy of wire is ammonia; an enemy which is most potent, and which is found in any and all plastering; it is an incidental product in the setting of mortar, which is more especially found in patent plastering.

One of the greatest outrages perpetrated on electric wires is the use by painters of an acid wash to neutralize the acid in the plaster. This wash is composed chiefly of sulphate of iron and sulphuric acid; it quickly penetrates the plastering, and by its action on the nitrates contained therein evolves ammonia, which attacks and honeycombs the rubber insulation of the wire.

Within the last few weeks it has become necessary to remove all of the wire in a large building in this city, owing to just such barbarous treatment as that described. The only protection against ammonia that I know of is a waxy covering which is used on the best grades of

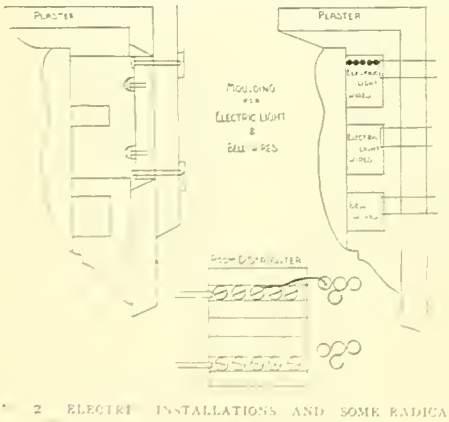


FIG. 2. ELECTRIC INSTALLATIONS AND SOME RADICAL CHANGES IN GENERAL SYSTEMS OF WIRING.

weather proof wire. I generally specify wire which is covered with a braid saturated with some compound to strengthen and protect it. Other enemies of wire are rats and mice and roaches. My experience has been that the weather-proof compound already mentioned will prevent them eating the wire; they are fond of rubber, but do not like wax. In addition to its chemical properties wire should have the ability to stand rough usage and bending without perceptibly breaking its insulation.

The present method of running distributing wires in fire proof buildings is, first, placing directly beneath the plastering with cleats; second, enclosing in interior conduit tubes; third, and most desirable, is running wires from cut-out cabinets in moulding to the rooms, and then under the plastering in interior conduit tubes to the outlets. This last method I have adopted almost exclusively. Fig. 2 shows one form of corridor moulding which I use. It has three compartments, one for each polarity of the light wires, and one for the bell wires. When leaving this moulding interior conduits carry the wires to the outlets. This is a better method than all interior conduits, as architects are every day limiting the thickness of plastering. Originally 1¼ inches of plastering was considered about right, now ⅝ inch is considered too much; in fact, many architects complain bitterly when asked to use enough plastering to cover ¼ inch tubing; but the greatest objection to running interior conduits clear back to the cut-out cabinets is that a large number of tubes are brought to one point and it is almost impossible to make the plastering adhere to them.

Many architects think that interior conduits should only be placed in the flooring. I object to this, because it is almost impossible to lay tubing in the flooring and to prevent them from being broken to pieces by the workmen. Theoretically it is a perfect way of wiring, practically it is anything but satisfactory in my estimation. I object to the indiscriminate use of interior conduit from the fact that a slight settling of the building will break and destroy the tubes in such a manner as to make them useless for the purpose for which they are intended. I do not wish to be understood as being opposed to interior conduit, as in 95 per cent. of my work I use it; but I believe in restricting its use to its proper place—using it in short runs between outlets, and then having some form of moulding to carry the wire back to the cut-out cabinets. In office and hotel buildings this is especially applicable. The amount of conduit is reduced to a minimum and the liability of breakage from settling of the building is reduced in proportion.

For convenience of testing, I prefer an individual distributer, which consists of a horse shoe cut-out, having no fuses. This can be placed in the center electrolier of the

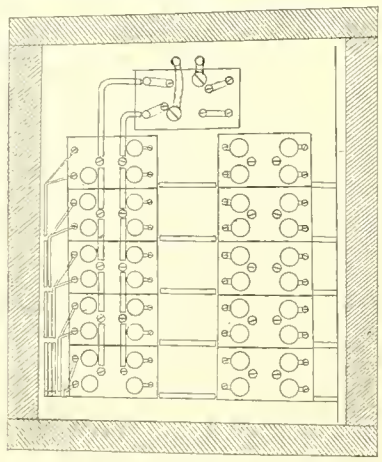


FIG. 3. ELECTRIC INSTALLATIONS AND SOME RADICAL CHANGES IN GENERAL SYSTEMS OF WIRING.

room from which a circuit will run to the outlets, or, where possible to do so, I use a block, which is placed in the moulding at the entrance to the room. All wires are run from the block to the outlets. In case of a ground in any line in this room, it requires but a moment to uncover this box and discover the line which is grounded.

All work described so far is in strict accordance with the rules of general wiring as pronounced by good authorities up to date. I wish now to disgress somewhat from orthodox rules and suggest some changes which are more or less startling, depending upon the amount of thought that has been given the subject. When the matter was first presented to me it did not strike me favorably, but as I considered the question further I became convinced that the innovation would sooner or later be adopted.

There are three danger points in electric light plants: First, the switch board; second, the cut-out cabinets; and third, the liability of ground on a circuit.

Grounds can be avoided by the use of good wire, by using insulators to carry all risers and feeders, and by distributing in moulding and interior conduit as described. I would consider that a model plant, in a modern office or hotel building, would consist of no less than three and not more than five dynamos, a slate switch-board properly mounted with instruments arranged tastefully thereon, the best quality of rubber covered, braided and slicked wire, mains and feeders run upon porcelain or glass insulators, cut-out cabinets made of slate or marble, something after the fashion of that shown in Fig. 3, with all connections on the face. Up to this point the plant would have been made according to the best and most approved system of wiring, but here I would make a departure, by bunching my distributing wires together, wires of opposite polarity being placed side by side in the same raceways, as shown in Fig. 4. This raceway would be lined with asbestos paper, with several coats of a good fireproof paint, or made of fireproof material throughout. Opposite each room I would place an individual distributer similar to that already shown. The greatest amount of current to be allowed on one circuit I would make eight amperes. I would so construct my fuse block that it would be impossible to place a fuse therein with a greater carrying capacity than eight amperes. No fixture could be used unless it be provided with an insulating joint, which must also carry the canopy. It is quite a common thing to place a good insulating joint on a fixture with a canopy which grounds the fixture by shunting the joint.

Fig. 5 shows the common method of insulating (?) fixtures. Electric gas lighting work would not be accepted on my fixtures unless the same quality of wire was used as in the rest of the installation. No ground would be permitted in the gas lighting circuit. No drop cord smaller than No 16 B. & S. could be used and no wire smaller than No. 14. These suggestions I am satisfied are in the line of better and cheaper construction The reasons are; First, wires placed behind the cut out box are generally arranged in such a manner as to make it almost impossible to trace them, which is in violation of the board rule that

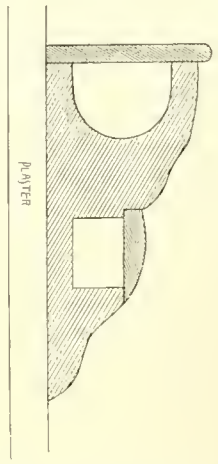


FIG. 4. ELECTRIC INSTALLATIONS AND SOME RADICAL CHANGES IN GENERAL SYSTEMS OF WIRING

all wires should be accessible for repairs and renewal at any time; second, the bunching of wires is a cheaper and neater method of running than where opposite polarities are separated.

When electric lighting came into existence it had no precedent except that of telegraph work and rules, hence telegraph practice was followed. Wires were separated as far as possible; it was argued by many that wires of like polarity should be kept apart for fear there might be a difference of polarity between them, and in one case no longer ago than last summer an insurance inspector insisted that the wires of a loop running to a switch were of different polarity and liable to short circuit.

The safety valve of electric lighting is the fuse. The most dangerous current that we can have is known by some as the "sneak" current and is one that is so slight as not to affect the fuse and open the circuit. The indiscriminate mixing of polarities is especially to protect us against the 'sneak" current. With the present system wires become bruised at a certain point, the insulation is injured, the breaking of a water pipe causes a ground, electrolysis takes place, the wire becomes oxidized and attenuated, and finally causes an arc, which may result in a fire. In the system which I am describing a short circuit would very quickly develop and the fuse would be blown, which would warn the electrician that something was wrong. Repeated blowing of fuses would cause an investigation, the trouble would be

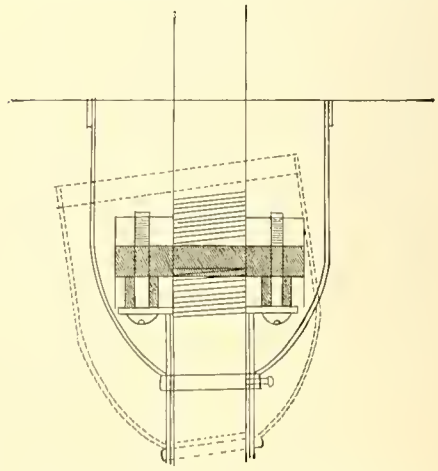


FIG. 5. ELECTRIC INSTALLATIONS AND SOME RADICAL CHANGES IN GENERAL SYSTEMS OF WIRING,

discovered and remedied. Danger from short circuiting would be comparatively nothing, for the faithful fuse, ever on duty, would give warning of danger. In fact, it would not require a great stretch of imagination to conceive of placing a false lining on the door of the cut-out cabinet in such a manner that the blowing of the fuse would indicate on an annunciator in the engine room where the fuse had blown, thus notifying the engineer in advance of the inevitable angry tenant.

As to the use of eight amperes on a circuit instead of eight lights, as is the present rule in Chicago, I believe there can be no serious objection made. "Lights" is an indefinite term and depends entirely upon the voltage employed for its value in current. The only object of limit-

ing the amount of current on circuits is to reduce the liability to destroy sockets by short circuiting. A number of experiences have convinced me that eight amperes properly protected by an eight ampere fuse will not destroy a socket by short circuiting. If the fuse is warm and other lights are on the circuit there is not the slightest danger of injuring it.

To conclude, I will say that the plant designed after the plan outlined would have an economical range in the dynamo capacity, and an economical loss in the wires, which, by the way, is a point that many do not seem to appreciate; in fact, one building is being wired to-day in Chicago with wire several times larger than needed, the owner probably following the logic of the man who drank the whole bottle of medicine, with the remark that "if some of it was good, more was better," or the son of the Orient who went to purchase a pair of shoes found that whereas a pair of No. 6 would exactly fit him, that a pair of No. 12 would cost the same money, so he took the No. 12 shoes.

A plant should be designed with a very small loss at the average load; this loss will vary with the character of the building. Very few buildings operate any where near their full capacity at any one time, but if they should for a few minutes in the day require their full capacity the excessive cost of coal expended for that short time would nearly compensate for the interest on the copper, which is a fixed charge against the plant.

This method would reduce the cost of distribution to a minimum, danger of grounds would be almost entirely removed, and with improved fixture connections I doubt whether a better plant could be devised

It is true that his plant would not coincide with the city inspection rules of Chicago to-day, but the history of our inspection department has been one of incessant warfare against bad work and in favor of better and safer installations. The gentlemen who compose Prof. Barrett's staff are progressive, active, and thoroughly alive to the interest of the electrical profession, and I am satisfied are willing to make any change or alteration in the present rules that would make our work better, safer and more in accordance with good engineering; and we all feel that they are working to accomplish this laudable object. When I say that these gentlemen are working I wish it understood that I mean it literally. When you consider that four inspectors are required to thoroughly inspect 498 isolated stations operating 646 arc lamps and 132,521 incandescents and 21 central stations operating 9,300 arcs and 150,000 incandescent lamps, all of which are irregularly distributed over 174 square miles, you will understand that they have plenty to occupy their minds and time.

Single Phase Alternating Motors.

To the Editor of the WESTERN ELECTRICIAN:

My attention has been called to an article appearing in your valuable journal on "Non-synchronous Motors for Ordinary Alternating Currents," by C. E. L. Brown.

I beg to state that motors of the kind he describes are not unknown to the art, as a reference to my United States patent No. 407,844, filed Nov. 17, 1888, will show. In fact, I sent to the Paris Exposition of 1889 a small single phase alternating current motor with arrangements for starting. This motor was built in accordance with the principle pointed out by Mr. Brown as arising from his own observations. Not long after I made my experiments which led to the transformer motors I found that such a motor could have its armature coils kept on short circuit and run in either direction after a start had been given to it. The original motor had a single inducing or field circuit and an armature with three coils and a commutator similar to that of a Thomson-Houston arc machine, and connected, movable, straddling brushes, whereby the period of short circuiting of the armature coils could be increased after starting to include the whole period, and maintain them on closed circuit.

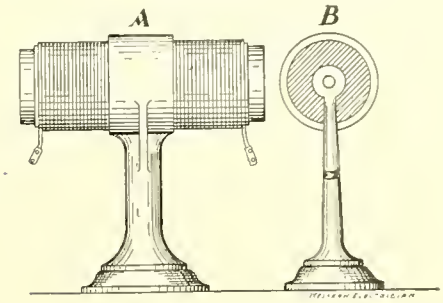
This was followed by the construction and working of many such machines with different arrangements of winding and means for starting. I have no hesitation in saying that, had it not been for the comparatively high frequency of alternating currents in use, namely, 125 to 130 per second, a large extension of the use of such motors would have taken place by this time in the United States.

The motor on this principle which was exhibited at Paris in 1889 was described in a number of the technical journals of that time. It had a commutator which was only used in starting. The rotating part had its coils connected with the commutator, and the brushes at starting were included in the alternating current circuit driving the machine in series with the inducing field. At a fairly good speed a centrifugal device inside the commutator short circuited the segments and placed the revolving coils thereby on a maintained short circuit, and the motor at once speeded up to nearly synchronism. Even at 125 periodicity the motor was efficient, the only drawback being that its weight output was less than could have been obtained with lower frequency. The principle of such single phase motors may be illustrated very prettily by the accompanying illustration. Let *A* be a coil with iron wire core energized by alternating currents so as to produce an alternating field, and let *B* be a wheel made up of iron disks at the center, around which is a rim or band of copper overhanging the edges of the disks. This wheel is mounted on pivots and started in rotation mechanically in either direction. After this it will increase in speed and torque up to a certain point, depending on the frequency of the currents in *A* and the friction to be overcome. That the direction of motion is indifferent may be shown by turning the wheel on a vertical axis so as to present to the pole the opposite end of a diameter. The rotative action I have formerly described as being due to translation lag, that is, a lag due to the traverse of a conductor conveying current past the pole, whereby the action of the current in that conductor becomes displaced in the direction of motion and produces a moving field, the iron mass or body tending to accommodate itself to the direction of the lines in the moving field.

ELIHU THOMSON.

Electrical Laboratory, University of Minnesota.

Many western colleges have electrical engineering departments which are doing good work, and among these none has been more successful, considering the length of time that it has been in existence, than the school connected with the University of Minnesota at Minneapolis. The department was organized in the autumn of 1891, and forms a portion of the College of Engineering, Metallurgy and Mechanic Arts. It is in charge of Prof. George D. Shepardson, who is popular with faculty and students. The course of study covers four years' work, the last two being exclusively technical. The freshman and sophomore years are devoted largely to mathematics and general physics. In the junior year students enter the laboratory and begin work in electrical measurements, Ten hours

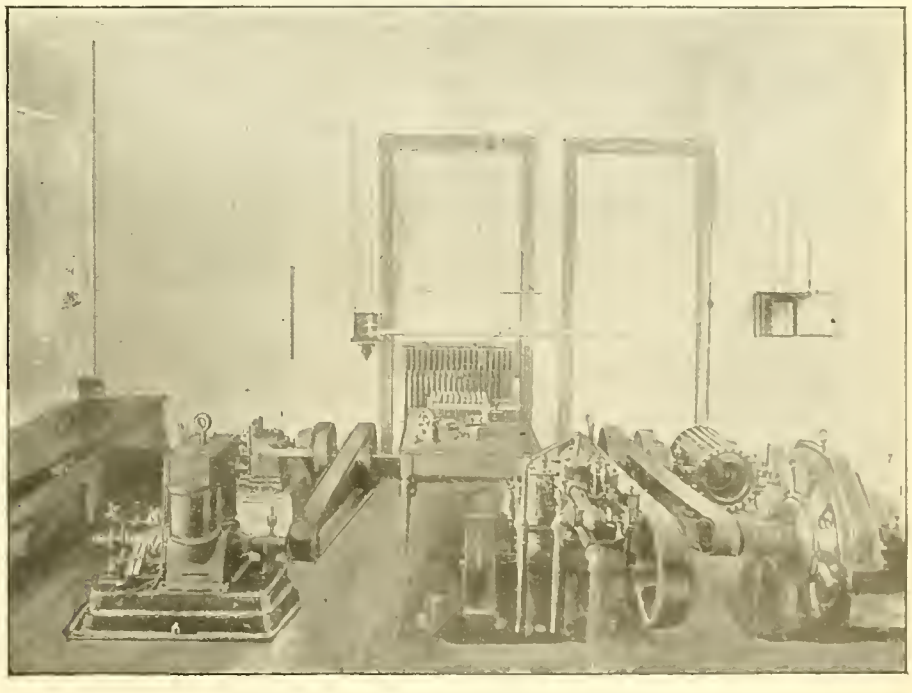


SINGLE PHASE ALTERNATING MOTORS.

per week is required. Determining current strength, electromotive force, capacity, resistances, etc., are a part of this work, as well as the study of magnetic measurements. The laboratory work is accompanied by a course of lectures—two per week the first term—in which is presented a careful discussion of the uses of electricity commercially. It includes also a general outline of lighting and power distribution. The lecture work of the second term covers the theory of the dynamo and other electro-magnetic machinery, of which practical study is made during the third term. The juniors are also taught to calculate the sizes of wire needed in electrical installations. The senior year begins with a series of lectures on the theory of alternating currents, while in the laboratory practical work with dynamo-electric machines, motors, etc, continues. Considerable work is also required in the drawing room in designing electrical apparatus, etc. During the second term the subject of electric lighting is taken up and a study made of the theory of arc and incandesdent lights, and also of the various systems in use. In the laboratory tests and practical comparisons are made of the different types of apparatus. The term's work includes also a course of four lectures per week on the design, construction and operation of isolated plants and central station for electric light and power. During the last term of the course a special study is made of electrical transmission of power. This time is also devoted to the completion of some piece of original work, report of which is embodied in the graduation thesis. Shop work is a feature of all four years. It includes carpentry, pattern making, casting, blacksmithing and work in the machine shop. Besides all this, five hours per week is devoted throughout the senior year to the theory, design and operation of steam engines. This is accompanied by laboratory work. During last year students designed and constructed various instruments, including a cradle dynamometer, a ballistic galvanometer, rheostats, volt meters, etc. They had practice in assembling and wiring dynamos, setting up lamps and accumulators, and assisted in tests of electric light and power plants in St. Cloud, Minneapolis and St. Paul. They also made tests of motors and cars on the Minneapolis street railway.

A view of the electrical laboratory is given in the accompanying illustration. The equipment includes a Westinghouse engine, a Fort Wayne alternator of 300 lights capacity, an Edison incandescent dynamo and a small Thomson-Houston arc machine. There is also, beside a collection of measuring and regulating instruments, a battery of accumulators and a number of primary batteries. The reading room, on the second floor, contains a number of electrical books and papers.

Prof. Shepardson is a native of Ohio and about 30 years of age. He graduated from the classical course of Dennison University in 1885, afterward taking his M. A. degree. In 1887 he went to Boston for the Edison company. In 1888 he began a course in electrical engineering at Cornell University, and, after taking his degree, became instructor in physics, his principal work being in the electrical laboratory. Two years ago he was called to his present position, and has already demonstrated his ability as an instructor in his branch. Prof. Shepardson is a member of the American Institute of Electrical Engineers and of the honorary scientific fraternity of Sigma Xi.



ELECTRICAL LABORATORY, UNIVERSITY OF MINNESOTA.

Electricity on the Erie Canal.

Much interest has been manifested throughout New York and in other states having artificial waterways over the proposition to propel canal boats by electricity. A bill has passed the Legislature and received the approval of Governor Flower of New York, appropriating $258,000 for improving the Erie canal. One provision of this measure is that $10,000 shall be used in experiments conducted under the direction of the superintendent of public works and the state engineer, with a view of determining the commercial practicability of utilizing electricity as a motive power on the canal. A report of the experiments will be submitted to the next Legislature and will form the basis of further legislation on this subject.

The Delaware Avenue & Clayton Railway company has been authorized to construct a street railway in St. Louis.

A Curious Action of Attraction by Alternating Currents.

By Elihu Thomson.

A curious case of apparent attraction of closed circuits in the neighborhood of an alternating magnetic pole which was found in experimenting on the repulsive effects is worth recording. This will be understood by reference to Fig. 1.

Let *P* be an alternating magnetic pole, produced by a bundle of iron wires surrounded by a coil through which alternating currents are passed, and *C* a copper disk considerably smaller than the pole end *P*. As the disk *C* is approached to *P* it will of course be found that it is repelled or that a certain force has to be overcome in bringing it nearer and nearer. It will be found, however, that instead of increasing as it nears the pole, after a certain position has been passed the repulsion diminishes, then disappears and is at last replaced by an attractive force of considerable amount, which increases down to the position of actual contact with the pole. It is assumed that the disk *C* be kept parallel to and central with the pole face *P*.

The explanation of this apparent anomaly is, I think, simple. The attraction appears to be due to the nearness of the disk *C* to the iron core. Currents are induced in *C*, which, owing to the small diameter, relatively, do not suffer as great lag as when induced in rings or disks which encircle the pole. These currents exert an attraction for the iron of the core, which at last becomes superior to the effort of the repulsion, which is feeble. The induced currents in *C*, in seeking a better magnetic circuit for their induction,

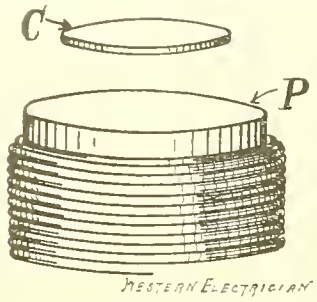


FIG. 1. A CURIOUS ACTION OF ATTRACTION BY ALTERNATING CURRENTS.

cause the disk *C* to approach the core. The strongest attraction will of course exist when the current which energizes the pole *P* is passing its zero value.

At this time the attraction will be understood by a glance at Fig. 2, where the magnetic effects of currents in *C* now have free action on the pole *P*.

A pretty modification of the experiment, and one in which both attraction and repulsion take part, is indicated in Fig. 3. The disk may be set in the position inclined, as shown, and the attraction at *b* may keep it from being thrown off the pole, while the repulsion at *a* sustains something less than one-half the weight of the disk in the inclined position shown. If the alternating pole be presented in a horizontal direction, it will also be found that the disk will adhere to the pole and slip down to a position below the center. If it slips too far down the attraction is at one replaced by a quick repulsion, which casts the disk away from the pole quite suddenly. With the pole completely inverted or facing outward the attraction will be sufficient, in some cases, to hold the full weight of the disk against the pole.

Corrections in Convention Proceedings.

To the Editor of the Western Electrician:

The official stenographer who reported the proceedings of the National Electric Light convention at St. Louis has made a number of blunders which appear in your edition of March 11th and which I desire to correct.

On page 123 of the issue of that date I am made to quote Dr. Bell as having stated that "it is not practicable to use multiphase machines over 1,200 volts." I referred to direct current machines, not multiphase; and called attention to the fact that Prof. Crocker had made the statement before the American Institute of Electrical Engineers that he had been running for some time direct current machines of 5,000 and 6,000 volts without any trouble whatever, and was now constructing one of 10,000. Further on in the same paragraph I am quoted as follows: 'I do not think Dr. Bell placed enough importance upon the application of the transformer in this country." This should read: 'The direct current transformer," or "motor transformer.'

On page 130 in my remarks upon the relative life of incandescent lamps upon continuous and alternating current circuits, I am made to state that "it is a well known fact that an incandescent lamp will last longer at a lower rate than at a higher rate of alternation." The expression I used was 'that it is a well known fact that an incandescent lamp would last longer at a low electro motive force than a high one.'

As the statements which have appeared in the technical papers are misleading, I should be glad if you would kindly insert these corrections.

William J. Hammer.

Siemens' Telephone with Siren Call.

The device shown in the accompanying cut consists of the Siemens' bi-polar telephone with the addition of a special hand-worked arrangement for calling. The latter consists of two diametrically opposed segments of soft iron, forming part of a brass cylinder, which the operator can rapidly rotate by means of a small crank handle turning a train of wheels, gearing with the armature. This rotation causes a rapid introduction and removal of the armature from the magnetic field below the soft iron pole pieces, and a corresponding magnetic change in their cores, which affects the home as well as the distant tele-

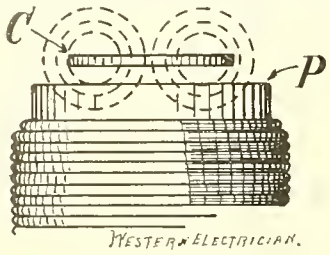
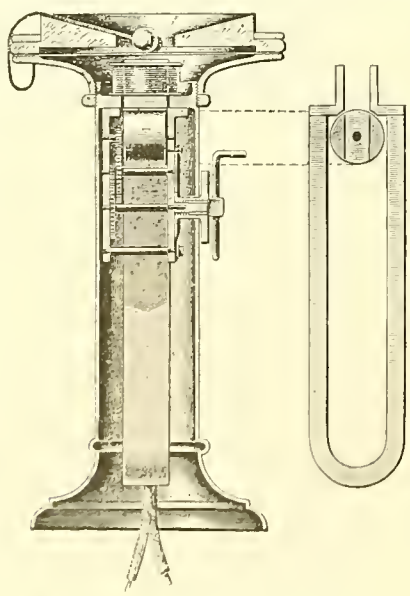


FIG. 2. A CURIOUS ACTION OF ATTRACTION BY ALTERNATING CURRENTS.

phone diaphragms, setting them both into vibration. In general the siren-like sound emitted by the telephone alone is quite sufficient for the purpose of a telephone call; but the small bullet which is attached to the cord may be kept resting on the diaphragm; it is brought into violent movement by the vibration of the latter, and acts as an intensifier of the telephonic sound emitted. The armature, if left to itself, would take up a position across the field below the poles, and weaken the magnetic field through the diaphragm. In order to avoid this, when the telephone is used for conversation, it is necessary that the armature be always brought into its neutral position and locked there. This is done by a special spring-catch, dropping a pin into a hole, which arrests the armature in the proper position. When a call is given this pin is first drawn out of action by a cam with a milled head, which, together with the crank handle for rotating the armature, projects outside the telephone casing. The cut is reproduced from the London *Electrical Review*.

A Four-Winch Electric Hoist.

The illustration on page 143 represents a new form of electric hoist designed for use in loading and unloading



SIEMENS' TELEPHONE WITH SIREN CALL.

the cargoes of vessels. Hoists for this purpose are located either on shipboard or on the wharf, preference generally being given to the former method. When this position is used the electric hoist has especial advantages over a steam hoist. It is more compact than the latter, an important point, on account of the value of space on the vessel's deck, and its superiority is also very apparent in cold weather, when the steam condensation in steam hoists causes a great loss of power. For use on vessels the electric winch-head hoist possesses several advantages over an ordinary drum hoist, as it takes up less space and is better adapted to the work of handling the ship's cargo. Several loads may, if desired, be lifted or lowered simultaneously by means of the different winch-heads, the control of each being independent of the others.

The machine shown in the illustration, which is manufactured by the General Electric company, consists of a base frame, a motor and regulating apparatus and two shafts, each with two winch-heads. The motor is carried on the upper edge of the frame and for convenience the whole hoist is mounted on three heavy wheels, the leading wheel being ranged on a pivot and fitted with a strong handle for guidance. The motor is enclosed in an iron frame in such a manner that it is only exposed in two small openings on either side, which give access to the commutator, brushes and armature bearings. When the hoist is in operation these openings are closed by canvas or sheet iron coverings. The winding of the armature and field coils is covered with a special waterproof composition and radial carbon brushes are used. The winch shafts are of steel with large diameters. Each winch is provided with safety pawls so arranged as to engage with a series of ratchets on the cap of the bearing. So long as the winch revolves at nominal speed the pawls are held out of action by centrifugal force. Should the supply of current fail while the load is being hoisted these safety catches engage with the notches on the bearing cap and the winch comes to rest, and thus prevents the load from doing any damage. The motor controlling apparatus is located within the base frame and below the motor.

This hoist is stated to have a net capacity of 45 horse

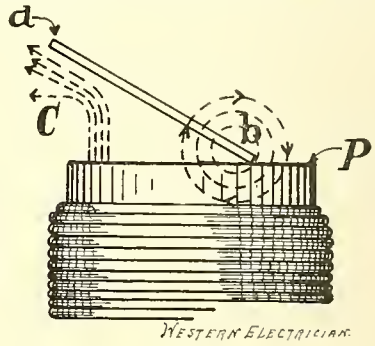


FIG. 3. A CURIOUS ACTION OF ATTRACTION BY ALTERNATING CURRENTS.

power at the winches, the motor running at the speed of 425 revolutions. The motors are wound for 110, 220 and 500 volt circuits. At the potential first named 360 amperes of current is required. The hoist complete weighs 8,000 pounds and has a lifting capacity of 3,000 pounds. The speed of lifting is placed at 250 feet per minute. The apparatus is six feet ten inches long, six feet seven inches wide and four feet seven and one-half inches high.

Development of the Incandescent Lamp.[1]

By Edward Weston.

The modern incandescent lamp consists essentially of three elements; the carbon conductor, the glass envelope, and the leading in wires. These are the essential elements of the lamp as the art exists today. The older incandescent lamps contained these same elements arranged in substantially the same manner.

The creators of the art of electric lighting—and I speak in this way because I do not think it is fair to disregard the work of everybody who has preceded us—understood the subject a great deal better than a great many people have given them credit for. The fact that the incandescent lamp played so small a part in practical work until a comparatively recent period, does not warrant us in failing to give due credit to the early workers. Indeed, the fact that no incandescent lamp was commercially used until a recent date is not due to the causes generally ascribed, but to others almost, if not wholly, overlooked by writers on the subject. These writers may, in my opinion, be divided into two general classes: First, those who have attained distinction in some other branch of scientific work, many of whom are apt to express their opinions rather hastily and without due consideration of the principles involved, on the possibility or impossibility of the application of some single scientific fact, or a number of such facts to a useful art; second, writers whose opinions are based on sentiment, or who are biassed or interested and are therefore frequently unable to look at things fairly or reason logically.

Among the first class of writers, you may remember, were distinguished scientific men, who expressed very strong opinions on the absolute impossibility of economically subdividing the electric light; either arc or incandescent. Two notable instances of the kind, which will serve to show how unwise it is to prophesy unless you make a careful study of the subject and take into consideration all the facts, ought to serve as a warning to scientific men. The two instances

1. Address delivered before the National Electric Light association at St. Louis, March 2, 1893.

I refer to, are those of the French electrical engineer, Hippolyte Fontaine, and the well known English electrician, W. H. Preece. The former is well known from his early work in connection with the introduction of the Gramme machine, and its use in electric lighting. Mr. Preece has for many years been chief-electrician of the English telegraph service.

Mr. Fontaine was a strong advocate of the arc light, and of that system which necessitated the use of a separate generator for each lamp, and was engaged in the effort to generally introduce such a system. He had little faith in the success of any other system of arc lighting, and practically none in the incandescent system.

Mr. Fontaine made a series of experiments on incandescent lamps, grouped in series, and also grouped in parallel. The current to operate these lamps, was derived from voltaic batteries, variously grouped. In these experiments, a rough effort appears to have been made to ascertain the strength of the current used with a single lamp, or a number of lamps, in circuit, and the value of the illuminating power of the lamps was apparently, roughly determined under the different conditions of grouping of batteries and lamps. But the experiments were wholly misleading for several reasons. In the first place, there was no absolute determination of the strength of the current, no determination of the difference of potential at the terminals of the lamps, and consequently, no determination of the energy required to bring a single lamp or a group of lamps to a certain candle power.

Mr. Preece attacked the matter from a similar point, and fell into errors fully as great, if not greater, than those made by Fontaine. He wrote an elaborate mathematical paper on the subject, which was published in one of the oldest and best scientific journals in the world, and it was republished in many of the best scientific and engineering journals and the substance of the paper was embodied in nearly all the books published on the subject of electric lighting, and was endorsed by the authors of such books, as an extremely valuable paper. The paper had the approval of many scientific men; it had the stamp of authority. In it Mr. Preece from dynamical considerations, mathematically demonstrated the impossibility of economically sub dividing the electric, light, either arc or incandescent. Notwithstanding this (with all due respect to Mr. Preece), the paper did not embody the truth; on the contrary, the whole mathematical reasoning was founded on error, and a misconception of the elementary principles involved in the production of the electric light.

Do you conceive it possible that a man could be so foolish as to suppose that if he put a kettle containing two gallons of cold water on the fire, it would take no more heat to raise that two gallons of cold water to a temperature of 212 degrees, than it would take to raise one gallon to the same temperature? Does it not appear reasonable to suppose that almost any school boy who had passed through the curriculum of one of our high schools, would be able to answer that question correctly, and at once, without resort to any mathematical formula? Is it not perfectly clear to the mind of any one in this room, that it would require at least twice the heat, or work to be done on two gallons of water to raise it to a given temperature, as would be required to bring one gallon of water to the same temperature? Substitute for water any other form of matter, and is not the answer necessarily the same? Furthermore, substitute for heat any other form of energy, and is not the answer necessarily the same? Of course it is. Simple as these facts may appear, they embody the fundamental principles of the electric light, and its sub-divisions, whether it be arc or incandescent.

Substitute for the water and the kettle, a mass of carbon equal to 1-10 of an ounce, and so proportioned and disposed as to permit it being brought to a sufficiently high temperature to become luminous or incandescent, by heat from any source of energy. Measure the energy expended in maintaining its luminosity or degree of incandescence constant. Now split this 1-10 of an ounce of carbon into ten equal parts, lengthwise or crosswise, and arrange them so that the ten equal parts can be made to constitute ten seperate luminous centres. It is manifest that we shall now have ten parts of carbon each equal to a 1-100 of an ounce. Now let them each be subjected to heat from any source of energy sufficient to raise the temperature of each of the ten small masses to the same point as that to which the large mass was raised and which they originally composed. Does it not follow as a matter of necessity that each mass of 1-100 of an ounce will require substantially 1-10 of the energy applied to the large mass to bring it to the same temperatere, and that each of the ten small luminous centres will give a light substantially equal to 1-10 of the light of the large mass, and that consequently the light from the whole of the ten small masses will be substantially equal to the light of the large mass which they originally constituted.

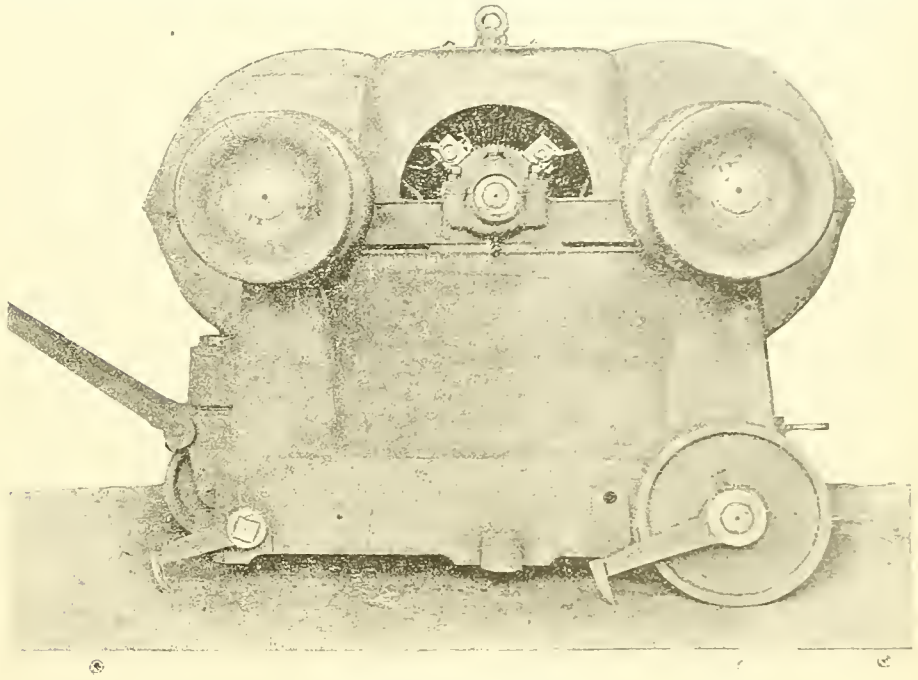
Broadly speaking, these are the principles involved in any system of illumination, and of necessity, they apply to electric illumination, either by arc or incandescent.

It must be admitted, however, that in actual practice large lights are somewhat more economical than small ones, and the reason for the greater economy of large lights is, and was perfectly understood long before the date of Mr. Fontaine's experiments, and Mr. Preece's paper. If these principles are so simple, how is it that there has been so much mystery and misconception in regard to this subject? How is it possible that men like Mr. Preece should have used such language as appears at the end of the elaborate mathematical paper referred to; language which unquestionably denies the possibility of the economical sub-division of the electric light.

The explanation of the error is that Mr. Preece assumed that when lamps were introduced in series in the circuit, there was an increase in the total resistence of the circuit which diminished the current flowing, and he failed to perceive that to overcome the increased resistence in the series lamps and bring each of the lamps in series to the same degree of luminosity as was the case when only one was in circuit it was only necessary to increase the pressure to such an extent as to force through the circuit of two or more lamps in series the same amount of current as was needed to bring a single lamp to its normal degree of brilliancy, or normal candle-power, if you prefer it.

Surely if a certain amount of energy was needed to obtain a light of certain candle power, it should not require more than twice that amount of energy to run two lights each of the same candle power as the single light, and so on in the same proportion. Mr. Preece utterly failed to grasp the simple fact that if a certain amount of energy was needed to raise a certain lamp to a certain candle power, two such lamps required twice that amount of energy, and if two or more such lamps were put in series, it was necessary, in order to deliver the amount of energy required by each lamp, to bring it to its normal candle power, to increase the electromotive force of the generator in simple proportion to the number of lamps in circuit in series.

In discussing the multiple arc system, he made an equally serious mistake, and made the remarkable statement that "the total amount of heat generated in the resistance will vary inversely as the number of the latter in circuit." Now every one of you know, and every electrician should know, that just the opposite is necessarily true. For with a suitable battery or dynamo, the amount of heat generated in the lamps, or resistances, is directly proportional to the number of lamps put in circuit. Thus with ten lamps in circuit, you necessarily have ten times the heat generated in the circuit that you have with one, and so on for any number, however great or small, provided the same difference of potential be maintained at the terminals of the lamps.



FOUR-WINCH ELECTRIC HOIST.

Long before the date of Mr. Fontaine's experiments and Mr. Preece's mathematical demonstration of the impossibility of economically sub-dividing the electric light, it was an accomplished fact in this country.

Careful students and inventors in this country held views entirely different from those of Mr. Fontaine and Mr. Preece; views identical with those I have already referred to in dealing with the simple principles involved in the sub-division of the light. Mr. Brush and myself had already quite economically run arc lights in series. In my early work, I looked at the matter more from the point of the simple principles previously referred to, supplemented by the further belief that if one lamp could be run on a machine and yield commercially useful results (of which there was no doubt), then there ought to be increased economy in runing many lamps from a single machine, whether in multiple arc or in series. Because I believed that the electrical losses could not possibly be relatively greater in a machine adapted to run several lights than in a machine adapted to run one light; and further because the mechanical losses should be relatively less in the former case than in the latter; and the cost of construction of a machine adapted to run a number of lights must necessarily be much smaller than the cost of several machines, each adapted to run only a single light.

But to return to the incandescent lamp. I am certain that it was not the conviction of impossibility of sub-dividing the electric light that restrained its development at a much earlier date. For one, I can say, in perfect truthfulness, that I saw fewer serious difficulties in sub-dividing the incandescent light than in sub-dividing the arc light. But there was the staggering fact of the inefficiency of the incandescent lamp as compared with the arc lamp. From the one it was only possible to obtain a small fraction of the light per unit of power expended that it was possible to obtain from the other; and, as you know, that difficulty has never been overcome.

Following the line of thought in the minds of those denying the possibility of the economical sub-division of the electric light there was another class of writers who pronounced it impossible to distribute the energy without such an enormous waste or enormous cost for conductors, as would render the investment wholly unprofitable. This in my opinion was the most just objection urged to any extensive system of distribution.

The next claim that there was no system of conductors which would meet the requirements and avoid enormous loss by escape before reaching the lamps. This objection was just as illusory as the objections to the possibility of subdividing the light.

Still another objection was that the light would be so costly as to prohibit competition with gas. And here let me say that the people engaged in the development of the business were guilty of the worse form of bad faith, on account of the outrageously absurd statements made by them concerning the cost of the light, and the still more outrageous statements of the amount of power required to produce it.

Passing over the objections urged against electric lighting and the hasty glance at the principles involved, we will now deal with a matter which I have no doubt will interest you, more as business men and station managers, namely, What is the best lamp—that is, the most efficient and most durable lamp?

It might as well be understood at once that efficiency and durability are, so to speak, antagonistic to each other with a given kind of carbon; that is to say, with a given kind of carbon and equal skill in making the lamps, as the efficiency of the lamps is increased the durability, or life time, of the lamps is necessarily decreased. But as you know there is a great difference in this respect between lamps made by the several companies. I am aware that many have claimed that the very noticeable difference in the durability of the various lamps is solely due to the difference in their efficiency, but this is not invariably the case. For some lamps which are just as efficient as others with which they may be compared are also much more durable.

As a matter of fact, there are a number of things that affect the efficiency and durability of lamps. Much depends on the care and skill displayed in making lamps; but supposing equal care and skill be employed in making lamps, there will always exist great differences in the efficiency and durability of lamps, due solely to the physical characteristics of the material out of which the carboos are made, and in some instances, to the treatment to which the carboos are subjected either before or after they are put in the lamps.

The material from which the carbons used in the modern incandescent lamp are almost invariably made is that substance known to chemists as cellulose. This is a general term employed to cover a series of substances of substantially the same chemical composition, and which forms the principal part of most trees and plants. It covers woods generally, such as cane, bamboo and other woods; woody fibre and fibres of plants generally, cotton, linen and similar substances, and material made from them, such as paper, thread, etc. In a few cases a substance somewhat resembling cellulose is employed, namely, silk.

Mr. Townley, in his paper, divided the lamps in use into three classes, based on certain characteristics of the carbons. While it is undoubtedly true that all lamps at present in use differ practically only in regard to the physical characteristics of the carbons used (setting aside the question of care and skill exercised in making them) or the slight differences in size and form of the loop, yet the classification by Mr. Townley is too restricted to do justice to the subject, because on the physical characteristics of the base from which the carboo is made, the practical value of the lamp will largely depend.

In most of the early forms of incandescent lamps, the

(*Continued on page 145.*)

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IN commenting upon the report of the sub-committee of the International electrical committee of the American Institute of Electrical Engineers, containing recommendations for the conduct of the World's Electrical Congress (WESTERN ELECTRICIAN, January 21, 1893) *L'Industrie Electrique* says that on the whole the document is to be indorsed, but it calls attention to the definitions of inductivity and magnetic reluctivity. It says: "There is here a mingling of units and quantities that is absolutely incoherent. The sub-committee has lost sight of the fundamental principle which should govern the selection of quantities and units. Thus we cannot admit for a moment that reluctivity should be defined as the reluctance per unit volume, or that voltage should be adopted as a synonym for difference of potential, for then, in following out the principle, it would be necessary to sanction the words amperage, ohmage, wattage, joulage, as synonyms of current strength, resistance, etc., which would be simply absurd. Science should create a language; not slang."

WE have received a letter from Prof. S. P. Thompson in relation to a brief editorial published in the WESTERN ELECTRICIAN of February 4th, in which reference was made to a lecture on "Lamps," in which Prof. Thompson was reported to have said that an American financier flourished a $100,000 bill in Edison's face, promising him it if he would subdivide the electric light. The statement was absurd, of course. Prof. Thompson, however, disclaims all responsibility for the story, which he ascribes to the inaccuracy of a newspaper reporter. "I certainly never said anything about anybody flourishing a $100,000 bill in Mr. Edison's face," he writes. "I did refer to the late Col. Dexter and his friends, who had the courage at the outset to subscribe the cash necessary to start Mr. Edison on his electric light work."

Of course our correspondent is entitled to this correction, which is cheerfully made. The misleading report was printed in one of the leading English electrical journals, which is usually accurate, and we naturally assumed that it was correct. Prof. Thomson deprecates the impression that he sought to depreciate the work of Edison or of Americans, and we are glad to give him the benefit of the denial.

INTEREST in the project of propelling canal boats by electricity is revived by the announcement that the Legislature of New York has passed a bill providing for an appropriation of $10,000 for conducting experiments in this line during the coming season. This bill has received the approval of the governor, and arrangements will be made at once for carrying out its provisions. The officials under whose supervision the work will be done will report the result of their experiments to the next session of the Legislature. If the report is favorable the next Legislature may make some provision for an electrical equipment for the great waterway through the Empire state. No doubt the railroads would oppose such a measure—and the powerful lobby at Albany has much to do with shaping legislation—but the universal interest that is shown in the measure throughout the state may force the Legislature to decide in favor of the people and against the corporations. Whatever becomes of the project so far as New York is concerned, there is no doubt that the legislation just enacted will be fruitful. There are many places in this country and in Europe where electricity could be substituted for animals, and no doubt in these places advantage will be taken of New York's experience.

THERE are few persons in the country who can write so fairly and intelligently on the relations of insurance men and electric lighting and power companies as George P. Low of San Francisco, whose paper on "Electric Stations as Insurance Risks," read before the Fire Underwriters' Association of the Pacific, is given in this issue. Mr. Low has had long experience in inspecting central stations for fire insurance companies and cannot be accused of undue leniency toward the former. Nevertheless he fully appreciates the great importance and wonderful growth of electrical development and keeps abreast of the times. He is therefore in a position to judicially observe the attitude and trend of these two great interests, which are, unfortunately, so often in conflict. He finds that the present dissatisfaction is due to errors on both sides—the underwriters in endeavoring to exact the old-time rates for stations constructed on the lines of the best modern practice and the electrical men in objecting to the plan of co-insurance. In conclusion Mr. Low warns the insurance men to take heed of the improvements made in electrical construction and revise their rates thereby, else they may some day wake up to find the electrical fraternity carrying its own insurance. While this contingency may seem remote, we cordially commend the paper to the attention of all central station managers. Only good can result from taking advantage of every precaution in station and line construction.

THE resignation of Frederick Sargent as general manager of the mechanical and electrical engineering department of the World's Columbian Exposition company will excite general regret among the members of the electrical fraternity. Placed in a position where he was harrassed by annoying restrictions and red-tape regulations on the one hand and the ceaseless importunities of self-seeking contractors on the other; seeing the weeks and months roll by with work undone that should have been accomplished long before, and this through no fault of his own; chafing under unwise interference by those high in authority, and smarting from a sense of injustice—it is no wonder that Mr. Sargent gave up the fight. He has given two years of hard work to the World's Fair, and leaves with every engine provided for the exposition free of cost, and this for a plant of nearly 30,000 horse power. He has laid out a power station that has excited the unqualified admiration of all visitors, and which will remain as an evidence of his ability so long as the exposition lasts. No doubt Mr. Sargent has made mistakes, but we are convinced that any errors into which he may have fallen have sprung from a desire to get the best possible results for the fair and to hasten the work as much as possible, even if, in doing so, he violated some of the numerous restrictions which the peculiar government of the enterprise has thrown about the work. Those who realize the amount of work to be done on the service plant will deeply sympathize with any effort to "push things," even if the routine of the circumlocution office is disregarded. It will be remembered, too, that Dion Geraldine, one of the most efficient officers the exposition ever had, was guilty of this offense and was dismissed for his pains. The World's Fair has had no more capable and zealous servant than Frederick Sargent, and it is a great pity that it is to be deprived of his services.

OFFICIAL courtesy will not permit the United States Senate to consider a bill directing the United States Circuit Court for the District of Massachusetts to take up the Berliner telephone case and give it an immediate trial. This at least is the excuse of Senator Dixon, chairman of the committee on patents, for declining to introduce a bill of this kind into the senate. While such a measure would be unusual, it would not, we think, be without precedent, but even should this be the case the senate would be justified in directing that special measures be taken to bring this litigation to an early conclusion. The magnitude of the interests involved and the urgency of the demand for an immediate decision, aside from the serious character of the charges that have been made, would seem to warrant a departure from ordinary procedure.

The case in point is the action begun by the government to annul the patent granted Emile Berliner on November 17, 1891. One of the grounds upon which this action was begun was that the issuance of the patent was delayed fourteen years through the machinations of the telephone company, with the idea of extending the term of the monopoly enjoyed by that corporation. It is further charged that the application was materially changed while it was in the Patent Office, and other claims are made reflecting upon the Bell company. The complaint in this case was reviewed in the WESTERN ELECTRICIAN of February 18th. The experience which the government has had in its litigation with the Bell company would appear to justify the claim that unless some special means of expediting the present trial are resorted to, there will be little hope of the public securing the benefit which would result from a possible annulment of the patent. The most important case of this kind on record in which the government and the telephone company have engaged was that begun by Attorney-general Garland March 23, 1886, to annul the original Bell patent. This patent expired March 7th, and the case is still pending; in fact, it has made no material progress since the action was six months old. Ridiculous as it may seem, the United States Circuit Court for the District of Massachusetts, on February 24th, at the request of the Bell company, extended until August 25th the time in which the company may present testimony in this suit. In order to prevent a repetition of this scandal it was deemed advisable to secure legislation that would compel an early trial of the Berliner case. The policy of the telephone company in keeping the application for this patent so long in the Patent Office would indicate that it was determined to follow the same course as that pursued in the litigation over the old Bell patent. It is of course the duty of the government to thwart this purpose, and in justice to other inventors and investigators in this line as well as the public generally, there should be an early settlement. If the Bell company is entitled to a continuation of the monopoly it is now enjoying, that fact should be established, and that corporation should assist in bringing about this decision as early as possible. The general belief that the Bell company has a weak case but a big bank account, and is relying on the latter to secure delays and possibly defeat the government upon technical grounds, will not improve the standing of that corporation in the eyes of the public, or make the people look more kindly upon the petitions of its "exchanges" for privileges and franchises.

Development of the Incandescent Lamp.

(*Continued from page* 143.)

carbons were made from substantially the same material as the arc light carbons with which you are familiar; that is, from powdered coke or powdered gas retort carbon, mixed into a paste with some cementing substance like sugar, tar or pitch, which served to bind the particles of pulverized carbon together into a pasty mass capable of being worked into the desired form. The cementing material is during the operation of baking, decomposed, the volatile constituents escaping and leaving behind some carbon which bound the particles of gas retort carbon or coke into a porous but quite strong mass.

On examining such a carbon under the microscope you will find that it has a fine granular structure, the size of the cemented particles being dependent on the fineness of division of the original powdered carbon.

It is generally supposed that such carbon is unsuitable for use, as the slender carbons of incandescent lamps. This is an error. If properly prepared it is very good indeed, much better than two of the carbons used by Mr. Edison in some of his first lamps. It is also quite flexible and quite strong when made as thin as carbons now generally in use.

I would suggest the following classification as being more useful than that proposed by Mr. Townley:

First, carbons made from cellulose, the physical characteristics of which have been modified by some process of manufacture which has more or less broken up the fibres or rearranged them and bound them together mechanically. Under this head I would include paper, cotton or linen thread, or braid, and as being closely allied, I would also include silk thread or braid.

Second, carbons made from the previously named manufactured products, but which have subsequently been subjected to some chemical process, and thus form a more or less perfect mechanical and chemical union between the interlaced fibres.

Third, carbons made from wood by simply splitting the wood in a direction as nearly coincident with the direction of the fibres as possible.

Fourth, carbons made from any of those already mentioned, but for reasons which I shall presently mention, exposed to the flashing process or hydrocarbon treatment.

Fifth, carbons made from a perfectly homogenous base, about which I shall have more to say later on.

To those engaged in the manufacture of lamps it is well-known that the structure of the carbon resulting from the use of any one of these primary bases or substances out of which the loop is first cut, is precisely the same as the original base.

Thus, if paper be used as the primary base, every fibre and every defect existing in the paper will exist as perfectly after carbonization as before. The same is true of carbon made from any other material; that is to say, the carbon preserves with absolute fidelity the arrangement, structure and shape of the substances of which they are made. It follows, therefore, that every defect existing in the material of which the carbon is made, no matter how great or how small, exists also in the carbon.

You, as electrical men, will readily understand that any defective contacts in any part of an electrical circuit causes the appearance of much more heat at that spot than would appear if the defective contacts did not exist. You also know that if some section of a conductor carrying a current be thinner than it ought to be, much more heat appears at that section than would be the case if the conductor was of the proper cross section throughout. None of you would think for a moment of taking a lot of thin copper wire, cutting it into short lengths, and simply interlacing them together and using them as the bus bars or main conductors for your circuits. You know well enough that such an arrangement would cause you much trouble by defective contacts, and possibly result in fusion or burning off of the mains.

Now an untreated carbon, made from paper, is substantially such a main, and of course, it is very defective; first, because the fibers are not firmly bound together, and secondly, because the paper not being of uniform thickness, nor of uniform density, the carbon is also not of uniform thickness or uniform density. Put such a carbon into an electric lamp, put the lamp in a circuit where you can control the strength of current, turn on a very feeble current at first; if no part of the carbon begins to glow, increase the strength of the current very gradually, and you will notice that some part or parts of the carbon begins to glow before the remainder shows any visible signs of heat. Increase the strength of the current again, and you will generally find that some part or parts of the carbon are vividly incandescent before the other parts are above a dull red.

These vividly incandescent spots are the spots of greatest electrical resistance in the loop—the spot at which the loop will fail, long before the period of usefulness of the loop as a whole has ceased.

Now what is true of carbons made from paper is more or less true of carbons made from cotton thread, linen thread and silk thread. The average life of such carbons would probably not exceed 150 hours; somewhat more in the case of thick carbons, and much less in the case of thin ones. With such carbons, I question whether the incandescent light would be in existence as a practical art to-day.

And here I hope you will pardon me if I say a few words in regard to some of my early work on the incandescent lamp. I met with these very difficulties in trying to secure uniform carbons, and they appeared in a very exaggerated form in the kind of carbon I first attempted to use. I was familiar with the process of gas manufacture, and had known for years of that bugbear of the gas engineer, namely, the deposition of solid carbon on the inside of gas retorts, resulting from the decomposition of the vaporous and gaseous hydrocarbons evolved during the destructive distillation of the coal. I was also aware of the fact that the deposit of solid carbon formed very irregularly inside the retort, and seemed to be greatest where the temperature of the retort was highest. The thought occurred to me that if I placed my defective carbons in a carbon bearing liquid, vapor or gas, and then passed sufficient current through the carbon to at first raise the temperature of the defective spot to a red heat, the carbon would be deposited on the spots of highest electrical resistance and build them up, thus making the very agency potent in the destruction of the carbon, serve the purpose of building up and obliterating the defective spots. It worked, and in a short time I brought the hydrocarbon treatment to a degree of perfection, which left little more to be done. From my experiments I soon found that it was also very difficult to secure two or more carbons of anywhere near the same electrical resistance. I clearly foresaw that to get uniform lights it was necessary to do just as the gas engineer does. The same amount of matter in each lump is required, and the resistance of the carbons must be substantially the same. With the hydrocarbon process, this was easily accomplished by making the carbons all slightly smaller in cross section than was actually needed, and then depositing carbon on them in the manner described, until the defective spots were all built up, and, continuing the process a little longer, it was quite easy to make the carbons all of substantially the same electrical resistance. So that with a given electromotive force, substantially the same current would pass through all, when placed in multiple arc; if placed in series, they would all have substantially the same electrical resistance, and therefore, all require substantially the same expenditure of energy to bring them to the same degree of illumination.

Some of you may remember that Messrs. Sawyer and Mann were the first to patent this process of treatment, and it was not until some time after the issue of their patent that I filed my application for a patent for the same invention. The case was bitterly and stubbornly fought before every tribunal in the patent office, but was invariably decided in my favor. Some time after the issue of the patent, the United States Electric Lighting company brought suit against the Edison company for infringement of my patent. No effort was made to push the case on either side for several years, and until long after I severed my connection with the United States Electric Lighting company. Then the United States Electric Lighting company suddenly decided that the patent was a very valuable one and decided to push the case vigorously. They applied to me for assistance, which, for just reasons, was refused, and they went to argument with a case which was essentially weak in every point, when it could easily have been made conclusive, for an abundance of irrefutable proof existed of all my early work in this direction.

I will now refer to the characteristics of the second class. In this class some of the defects due to imperfect contact of the adjacent fibres are overcome by reason of the fact that the parchmentizing process converts the outer layers of the fibres into a glutinous mass, which unites the fibres to form a more or less solid body of cellulose. But this parchmentization of the outer surface of the fibres does not wholly destroy the fibrous character of the mass, nor does it make the cross section uniform throughout the length of the loop. It follows, therefore, that carbons made from this class of bodies are still very imperfect, and exhibit in use some of the serious defects of the carbons of the first class. Hydrocarbon treatment is nearly as essential with these carbons to obtain satisfactory results as with carbons of the first class, and that because of the existence of defective spots, as well as the necessity of equalizing the resistance of the carbons. The parchmentization process appears to yield better results with thread loops than with loops made from paper.

We now come to that class of carbons made from substances I have placed under the third head. They are referred to by Mr. Townley as untreated or natural burners. They are only natural in the sense that they are prepared from a substance found in nature, such as wood, bamboo, cane, or other similar substances, the fibres of which are more or less parallel and continuous and bound together by the natural cementing substance between the fibres. The principal objection to these substances as the base for making carbons for incandescent lamps arises from the fact that it is almost impossible to get two samples of wood having the same density and the great difficulty of splitting the wood into thin long lengths in places parallel to the fibres.

Mr. Edison showed excellent judgment in selecting bamboo as the base from which to make carbons for his lamps. For of all the woods available, it is probably the best for the purpose. Its fibres are very straight, it is quite close grained and splits admirably. Notwithstanding these advantages, it is not by any means perfect, and there has been much complaint regarding lamps made from it. Most of the lamps under proper test show defective spots in the loops, and few of them die as good lamps ought to, that is to say, they do not gradually die all over, so to speak, but fail at some particular spot which was initially weak.

Moreover, the variations in electrical resistance of the carbons obtained from loops of the same cross section and length is very great, even when great care is taken, and unless the carbons are submitted to some subsequent process after the first baking it is practically impossible to obtain even moderately uniform results. It is not to be expected that it is possible to find a natural product like wood to have the same density or even more than approximately so. Consider for a moment the conditions of growth of plants. Are they not similar in many respects to human beings? Products to a large extent of their surroundings, is it reasonable to suppose that any two trees, growing either close together or a long distance apart, shall have the same properties exactly? I think not. In other words, there must of necessity be considerable differences in the properties of the wood of such structure, due to climatic and other conditions, as well as those differences which are known to exist in the strength and character of the wood taken from the same tree.

Carbons of the fourth class include those made from any of the other three classes already referred to, but subsequently subjected to the hydrocarbon process.

There is no doubt about the general correctness of Mr. Townley's views concerning the advantages of treated carbons over untreated carbons. I am quite sure of the absolute necessity of treating carbons of the first class and possibly of the second class, in order to get commercially useful results. I am also quite sure that carbons of the third class—straight fibre, natural fibre, or bamboo type, or whatever you may choose to call them—are greatly improved by the hydrocarbon treatment properly applied.

I believe enough has been said on the effect of the charactistics of the base on the resulting carbon and its influence in determining the life time and efficiency of lamps to make it clear that what is really required to secure the perfect lamps is an absolute homogeneous carbon. With an absolutely homogeneous carbon of uniform cross section from end to end of the loop, the loop will not suddenly fail at a single point, long before the principal part has suffered sensible injury by use. Such a carbon will gradually die, so to speak, all over. Such a carbon, even if subjected to the most searching tests, will exhibit an absolutely uniform degree of incandescence from end to end of the loop. Owing to the non-existence of defective spots, this kind of carbon may be raised to a much higher temperature than ordinary carbons, and so be much higher in efficiency, and still give a much greater average life than any other carbon I know of. To obtain such a carbon it is necessary, of course, to secure a base having also a perfectly homogeneous structure. I secured such a base many years ago in several ways; but after securing the base, it took several years of work to overcome the difficulties encountered in making carbons from it. But the difficulties were all overcome, and the result amply repaid me for the labor and time expended. This way of securing the base is fully described in U. S. patents No. 264,987 and dated Sept. 26, 1882.

The characteristics of the carbon and it's advantages are set forth in another patent issued to me on Sept. 26, 1882, and No. 264,986. Within the last year, I have made many improvements in the method of making these carbons.

Such a carbon requires no treatment to make it better adapted for use in an incandescent lamp. If properly made, it most perfectly fulfils all the requirements of the art as it exists today. It makes the most efficient and durable lamp known—the thing you want. It is cheap. It exists, and yet you cannot get it. Why? Turn to the people who have been conducting the manufacturing branch of this business and ask them that question. Do you think you will get a satisfactory answer? In the struggle for the control of this whole business, and it has been bitter, and is still a bitter one, the general interest of you as station managers, and the broad interest of the art as a whole, have been largely overlooked. Yes, even the best interests of the manufacturing companies have also been overlooked. I am of the opinion that if the manufacturing companies had turned their attention from the suicidal effort to annihilate each other, and had devoted some portion of the enormous sums expended in various ways, honest and dishonest, to effect that object (of annihilation), the art as a whole would have profited by it, and you in particular. The condition of the incandescent lamp business is to-day a peculiar one, and fraught with great interest to you as station managers. There are here to-day the representatives of two of the largest companies engaged in the business, each endeavoring to gain some advantage over the other. The litigation on the incandescent lamp has pretty well terminated. It has been a bitter, and in many respects, an unjust battle on all sides. I take it that the present paper is the outcome of the existing situation. One has the old lamp to sell, the other has a new lamp to introduce. A new lamp did I say? The glass stopper lamp is not new. The iron wires are not new. The carbon is not new. The absence of the information asked for in regard to what is meant by "super-treated burner" makes me hesitate to say that that is not new. But I think it improbable that those engaged in the use and experimental investigation of the hydrocarbon process left anything to be done in the way of extra treatment in that direction.

If the lamp stands service as Mr. Townley's paper indicates, the result is, in a measure, new.

Despite the fact of the presence of representatives of both these companies, I am sorry to have to say that I do not think that either of them are engaged in giving you the best they can give. I believe that statement is true, and I utter it in all sincerity.

I shall not attempt to deal with the formula presented concerning the durability and efficiency of the lamps referred to, it would take too much of your valuable time, and would probably not interest you, but I will say, that with the facts before you you will be able to perceive that it is a simple matter to make a lamp of any efficiency desired. By simply reducing the amount of carbon in the lamp, the carbon can be raised to a higher temperature, or higher degree of luminosity with the expenditure of less energy. It is claimed that a $2\frac{1}{2}$ watt lamp can be made to give a satisfactory life. I believe that is possible with good low voltage lamps under close regulation. It has been known for many years that a good low voltage lamp will be more efficient and still as durable as a high voltage lamp.

A bill has been introduced in the legislature for the incorporation of an electric railway co at Wallingford, Conn

Electric Stations as Insurance Risks.[1]

By George P. Low.

Probably few are aware that the first central station in America, if not in the world, from which electricity was furnished to the public as a lighting commodity, was established in San Francisco, and in studying electric stations as insurance risks, it is quite impossible for the fire underwriter to find a more interesting and instructive bit of history than that afforded during its brief existence. Like too many of the original electric stations, this pioneer plant was burned and in response to an inquiry as to the cause of the fire, the loss, etc, was received a letter from which was obtained permission to reproduce the following portion, which is so replete with interest that it is given entire:

Regarding the fire that destroyed our original works, I will state that the California Electric Light company was incorporated June 30, 1879. At that time electric lights had been in use in a number of mills and factories where power was already available, but no plant had been erected in any city for the purpose of generating electricity and distributing electric light to the public. Our people, that is, the writer and the other incorporators of the company, being unable to obtain any information regarding the business of electric lighting, because no public electric lighting had ever been done, determined to ascertain whether the business could be made profitable. We then erected a station, if station it could be called, for the purpose of ascertaining, first, whether it was practicable to distribute electric lights throughout the city to the general public, and, second, whether the people would take those lights and pay a price for them that would show a profit. Naturally, it being simply an experiment, the cheapest building that would answer the purpose was constructed; simply 4 by 4 uprights, a wooden floor laid in the ground and the sides of the building covered with sheet iron. The building itself was in the rear of where the Flood Building now stands and the entrance to it was through a tunnel. The boiler, engine, dynamos, oil house, coal pile and everything were huddled together in this one enclosure as cheaply as it was possible to do it. We realized at the time that the expenditure we were then making was, as stated, merely experimental and would be of no value if the business amounted to nothing. The machinery was stopped at midnight; no watchman was engaged; the building was in the rear so that it could not be seen from the street; and we have never been able to determine whether, in raking out the fire before shutting down, some coals were left on the floor which was saturated with grease, or whether some tramp came in to lodge; but we do know that on the morning of April 24, 1880, the fire took place. The apparatus was damaged, of course, but we congratulated ourselves that the fire took place when it did because we otherwise would probably have made temporary additions and would not so soon have constructed a proper station. There was no insurance loss on the plant, as it was uninsured.

The engine that was in that fire is to day in use in our station A, the boiler that was there used is also now in use in station A, of course, having new tubes and other repairs. Some of the dynamos that were there in use that came through the fire and were destroyed as far as ninety-nine dynamos out of a hundred are destroyed by fire, were repaired by ourselves, are now and ever since have been in use in our station A. Another of these "destroyed" dynamos was rewound and sold to the Selby Smelting Works and has been in use ever since. All these dynamos are practically as good as though the fire had never occurred, and the repairs to them simply represented the wire and labor of winding less the amount received for the old wire taken off.

At the present day the promoters of the electric lighting station in question appear remarkable in two respects: they were strictly the pioneers in what is one of the world's youngest yet most promising industries, and, what is of more immediate concern, their tinder-box property was uninsured. As an insurance risk, the original electric station was no worse than hardly any other similar plant erected prior to, say, two or three years ago; in fact, an overwhelming majority of all electric light plants placed previous to the last two or three years are of this wretched construction. In addition to being of historic interest, the station described is typical in several regards. We are all too familiar with the makeshift construction of the buildings that contained these original stations. In many cases the buildings were put up with absolutely no regard for fire risks. In them were placed valuable plants consisting of steam and electric machinery. Boilers and engines, with their fire boxes, flues, piles of fuel, steam pipes, oil and greasy waste, constitute a fire hazard necessitating on one hand the exercising of no little skill in its operation; dynamos, with their accessory appliances and wiring, all laden with a new and most potent form of energy, the hazards of which were unheard of and unknown. Then again, as defined in our typical station, the projectors of these early stations were all venturing in an untrodden territory. They did not know the fate their enterprise would meet; they simply advanced upon belief, and under such a condition it is but natural that every unnecessary expenditure should have been avoided. Everything was temporary and as cheap as possible; apparently no one knew how to erect a station on any other plan, or at least no one had done so.

The errors in electrical construction referred to should be considered as the strictly legitimate ones due to ignorance and inexperience in the rearing of a new industry. As such they are deserving of the utmost consideration, but in relating this story of evolution there remains to be told a darker feature which electrical people now admit though with reluctance. In adjusting losses on electric stations fire underwriters were many times imposed upon and swindled by station managers who insisted that the dynamos which had gone through the fire were total losses, whereas they knew that the losses were but partial ones. Time after time total losses have been paid on dynamos and other electric appliances which were damaged to one-quarter or one-half their actual value.

The fire underwriters, innocent of the frauds successfully practiced upon them, paid the losses, but they carefully wrote down in their ledger books the lessons learned to the effect that dynamos and all electrical appliances are easily damaged both by fire and water; that losses on them were almost invariably total, and that therefore they present unusual hazards which must be charged for in rating electric stations. In view of these facts, no one can charge the fire underwriters with bias in [illegible] at have been fixed upon the class of electric stations under consideration. Perfectly clear is the further fact that certain unprincipled electric concerns are largely responsible for the adverse opinions underwriters hold regarding electric stations.

[1] Read before the [illegible] annual meeting of the Fire Underwriters' Association of the Pacific, San Francisco, February 1, [illegible].

On the Pacific coast the losses due to electric stations has been limited, but experiences concerning any class of risk are contagious and the direful lessons learned by eastern underwriters have created a feeling of uneasiness in this line on the coast. As it is, probably one-half of the companies refuse to write on electric stations, no matter what the merits may be. The wisdom of making the prohibition absolute may I think well be questioned, for certainly few manufacturing plants contain less material of a combustible nature than the modern fire proof central station. The textile mills have their cotton, woolen lint and goods, grist mills have their feed, grain and explosive dusts, wood working industries their piles of saw-dust and shavings, but the modern electricity factory, with its thoroughly fire-proof construction, its steam plant, its dynamos, its switchboards and accessory instruments, is absolutely incapable of supporting combustion, for the iron and steel of the steam plant, the iron and copper of the electric machinery, the marble and slate of the switchboard, which within brick or stone walls, with iron roof and with concrete floors, constitute a modern electric station; these will not burn. The product of its whirring armatures, unlike the products of clashing looms, or grinding rollers or roaring planers, does not remain a constant menace to the premises. Instead, its product in the form of hundreds or thousands of horse power of marketable electric energy is unseen and unheard. The laws for controlling it, being now fully understood, are fully carried out and in the modern station the occurrence of fire is impossible. Indicate if you will a more desirable risk. To find its superiors we can only look to that most interesting plant under Niagara's cataract, or nearer home, to the new station of the Portland General Electric company, at Oregon City, where the water of the upper Willamette will cover the roof.

Such is the modern electric station, yet all is not told; so far as large stations are concerned the forms of dynamos and even of steam machinery now used are in a stage of transition. In these large stations the days of rapid moving machinery and the days of countershafting and of belting are numbered. So too are numbered the days when, in low potential incandescent central station dynamos, armatures shall consist of more or less delicate and destructible windings of wire and sensitive commutators as at present. Instead we have the slow speed multipolar generators, the only wire on which are the lathe wound and consequently cheap coils of the field magnets. Massive copper plates insulated from each other by sheet mica and all bolted rigidly to the fly wheel of the engine form the armature "windings," if such they may be called. As for commutator, it really has none, for the brushes bear against the ends of these armature plates. All is of very massive construction and the placing of a dynamo of this form on each end of the shaft of a triple expansion marine type engine produces a combined apparatus that at once eliminates all the hazards due to the use of shafting, belting, wire-wound armatures, and rapidly moving machinery. It also materially lessens the amount of oil used and obviates the hazard of heated journals by restricting the number of bearings to those on the engine.

Aside from a compliance with the requirements of the underwriters, the first radical departure from original ideas in electric station construction occurred in the development of slow speed multipolar direct connected dynamos of a form similar to the one just described. The engine-generators are being introduced in direct incandescent stations, and their advantages are so manifest, both in point of convenience and economy, that their general use may be looked for. Alternating current generators of somewhat similar character are also in use. In these either the armature or the field coils of the dynamo may form the fly-wheel of the engine, which is generally of the Corliss type. All coils for both armature and fields are lathe wound and cheap and are easily placed; hence from the underwriters' standpoint they are not as important a feature as the windings of the familiar type of alternator. This new engine-generator is larger by far than the low potential multipolar described but it appears to lack the massiveness which is characteristic of the latter. Despite this it forms a far superior risk to an equal lamp capacity of the usual type of alternating dynamo. Again greater simplicity in station wiring, with less possibility of accident from indifferent construction results from the use of these forms of engine-dynamos, for obviously if one large dynamo displaces ten smaller ones, instead of having ten dynamo circuits we still have but one, and the fewer the number of circuits the better.

Reverting to the destructibility of dynamos by fire and water, it is well to impress at the outset the futility of any endeavor to lay down general ideas that will apply to all machines. A specific knowledge of the form and make and capacity and even the date of each machine is almost invariably necessary in order to derive the amount of injury which it has received. To illustrate it is almost always necessary to rewind the armatures of dynamos that have been burned. If the shaft is not sprung, it is safe to say that the armature when rewound will be about as good as new if the machine is of a recent type, if not it may be all right when rewound or it may be worthless according to whether or not the laminated armature disks are insulated from each other by rust or by paper. The massive field castings or forgings if not cracked or warped are not susceptible of material injury from fire and frequently the only injury suffered by field coils is repaired by rewinding a few outer layers. The cost of the ordinary cast-iron castings of a dyamo does not amount to a great deal, as by reason of perfected machinery the labor of finishing them is reduced to a minimum, hence their value is, to a large extent, the value of the iron plus the freight. This being the case, dynamo builders do not care to take such castings in part payment for new machines, nor is it always profitable to purchase new parts to replace those destroyed for the reason that the prices of separate parts of dynamos are considerably higher than the same items would appear in the aggregate price when shipped as a complete machine. It is clear then that the cost of a "resurrected" dynamo might exceed that of a new machine, particularly if it is attempted to build it up from the fundamental forgings with new parts. Where duplicate parts may be made on the spot without sending to the factory, then the cost of the reconstructed machine, even if badly burned, will generally be considerably below its first cost. Particularly is this true of the latest forms of multipolar dynamos, which are sold at the same basis as the older form of machine, that is, according to their lamp capacity. But the new multipolar generators are of far simpler construction, there is far less labor in their making and they are considerably more efficient; but despite these conditions, which all cheapen the cost of construction, the cost of the machine is estimated on the old basis, and what may be called the royalty profits are correspondingly increased. If a fire all but ruins one of these machines, it may be practically rebuilt at perhaps half its original cost, and this may done without the interference of the parent company, as the reconstruction would be considered as repairs to a dynamo already sold. Should a station containing such a dynamo be practically obliterated, then the loss would be, of course, total, for to replace the machine a new one would have to be bought. This would bring out its cost value, which it should be noted is a spurious one when it comes to the settlement of a partial loss. The cost value may be annalyzed as the actual value plus the royalty. Doubtless the cost valuation is the proper one for consideration in case of total loss, but in settlement of partial losses it certainly is not. If the property is insured at the cost valuation, under the clause inserted in policies to the effect that the insurers, should they elect, may replace the property damaged, the settlement would naturally be made upon the basis of actual valuation, which would be an injustice to the assured. If insured at the cost valuation, the settlement of a partial loss on the basis of cost valuation would result in an injustice to the insurers. Again, an instance occurred last year where three dynamos were insured for about $16,000. They were bought three years previous and cost over $18,000. The station burned, and it was found that the machines could be replaced for about $10,000. They were clearly over-insured, yet the central station people, remembering their cost, did not realize it until the appraisement was handed in.

Here are pointed out two evils, the first being a possible occurrence, and the second an actual one, and in each a serious injustice results.

These matters are freely discussed among central station people, and it is hoped that they will soon be corrected. I hardly feel competent to offer a remedy, but I may venture to make a single suggestion, particularly in reference to the over-insurance of dynamos: Would it not be well to define in the policy the make, type, capacity and date of each insured machine. Knowing these details, the prices of various machines and the usual depreciation of dynamos, over-insurance could be prevented by the usual methods of compact procedure.

Reverting again to the destructibility of dynamos, a water damage, even if it be to a high potential machine, does not always necessitate its rewinding, and generally all that is necessary to restore it to its original worth is to dry it out thoroughly by baking. In some instances, however, the practicability of drying out depends upon the variety of machine—some machines would have to be entirely rebuilt, others will be repaired by simply rewinding, but generally a thorough baking will prove sufficient.

Coming now to railway generating stations, it has been pointed out in previous papers read before this association that the electric wiring of such power houses is far more simple than that of any other electric station, and that, therefore, they are subject to a smaller hazard from artificial electricity than either arc or incandescent lighting stations. Both railway power houses and incandescent stations are, however, more liable to damage by lightning than are arc lighting stations. The reason why this is so may be understood by comparing the action of a lightning stroke coming into the station over the outside line wires to the action of a hydraulic ram. Arc lighting dynamos are series wound, that is, the entire output of their armatures goes through the field coils and then to line; street railway and incandescent generators are shunt wound, that is, only a small part of the output of their armatures is shunted or diverted off through field coils. When lightning enters an arc station, therefore, it follows the line wire and circuits about the field coils, which does not occur in shunt-wound machines. Now a current of electricity that suddenly rushes into many turns of wire coiled about an iron core reacts upon itself in an action called induction, which, though not exactly so may be considered as nearly identical with the kick-back of a hydraulic ram. An unusual pressure is thus thrown upon the line and the lightning takes the short cut to earth afforded through the lightning arrester and is satisfied. The damage to dynamos usually attributed to lightning is not really due to lightning itself, but to the fact that the terrific potential of lightning breaks down the insulation of the machine, when the dynamo destroys itself by its own currents. Underwriters are generally exempted from loss on dynamos caused by lightning or "natural" currents, but should the burning out of an armature by lightning cause a station fire, then there should be no exemption from loss on the station. Protection from lightning is there

fore entitled to full consideration and it is almost safe to assert that a thorough modern station can be made lightning-proof. To do this, among other things, its iron roof must be well grounded, impedence coils of large self-induction must be inserted in the circuits and approved lightning arresters, with reliable earth connections, must be used. In the matter of lightning arresters it will be of interest to state that a new form of arrester is now made of an alloy that appears to be incapable of maintaining an electric arc. While a wicked stream of fire will play between two terminals of ordinary metal, it is stated that with this alloy any arc refuses to exist. Other lightning arresters accomplish practically the same thing by blowing out the arc by magnetic means.

For some time the hazard presented by trolley wires of electric railway systems has been the subject of no little consideration by fire underwriters, but in this, as in all other electric work, the fire hazard presented is best gauged by the methods of installation. It must appear to unprejudiced ones who are conversant with electric railway construction that electric railway people are now voluntarily placing themselves in the unfortunate position which electric lighting people were compelled to occupy in the "early days." Electric railroaders are inviting public censure and adverse legislation in persisting in the erection of unnecessary and sometimes hazardous overhead circuits in populous portions of cities, when means are at hand for obviating nearly every objectionable feature presented. There is no reason other than that of increased cost why all railway feeder circuits should not be placed underground, and if double arm poles are erected in the center of the street for the support of trolley wires, these being provided with proper guard wires, then the existing objections will be largely overcome. Underground and storage electric railway systems have been in use in Europe for two or three years, and if electrical people will pay for them and be content with slightly decreased dividends, or in making larger original investments, in return for the indorsement of a satisfied public, there is no reason why the same may not be accomplished in this country. As it is, they are inviting legislation that will overthrow the methods of cheap construction they are now placing.

Regardless of many opinions to the contrary it is not believed that great changes in the generation of electricity are to be looked for until some form of extracting energy from coal other than through the use of the steam engine has been devised. It now appears that the most marked developments in electrical work are to be expected in the use and applications of alternating currents. Continuous currents will hold their own for both arc and incandescent lighting and for power, purposes within limited areas, but after all the system that will best adapt itself to natural sources of power wherever they may be found, is the one that will mostly generally prevail. The wonderful flexibility of alternating currents, the ease with which they may be transformed up or down to any desired potential, the economy of transmission over great distances, the practical perfection of synchronizing motors and their equal economy with continuous current apparatus, these points and many others demonstrate the superiority of alternating currents for rendering available the energy of distant waterfalls or remote sources of cheap fuel.

Regardless of earlier apprehensions the fire underwriter should rejoice at every advance made by the alternating system. To illustrate: A larger, thoroughly modern fireproof building which I have in mind was lighted by incandescent lamps operated on the alternating system. The plant was operated to entire satisfaction for nearly a year when a direct current was substituted for the alternating source previously used and in a remarkably short time trouble after trouble was developed, circuit after circuit was burned out and eventually it became necessary to rewire the entire building. The insidious electrolytic action, which sooner or later disrupts continuous current circuits, is nearly though not quite inappreciable in alternating systems. Again in long distance transmission plants the tendency is to generate a low potential current, then to transform it by means of converters to a very high potential for transmission and then, at the point of consumption, to reduce it to a low and more safe pressure. This idea necessitates the consideration of a new form of station called the sub-station. It is absolutely without dynamos or any form of mechanical machinery, but all the energy of the generating station passes through it and its pressure is changed from a low to a high potential or vice versa. This is effected merely through the use of converters or transformers arranged in "banks" enclosed in fireproof vaults. In addition the sub station contains all the switchboard paraphernalia usual in the ordinary central station. It is in fact a complete electric lighting station, without dynamos or a source of power with which to operate them.

In alternating transmission is found therefore a new class of risk with which underwriters will have to deal, and it is well to ennumerate the additional safety features which the use of this method of electrical distribution entails. First, the generating station is almost invariably located at sources of natural or cheap power. Real estate is not so valuable there as in cities, and it is reasonable to presume that the station will not have any great exposure, or indeed, it may be absolutely isolated. Second, the dynamos will in all probability generate only low potentials, which offer less hazard than the high ones commonly used. Third, the use of high potentials is restricted entirely to the sub-station vaults referred to and to the outside pole lines. Finally, the switchboard and the valuable instruments thereon for controlling municipal and commercial circuits are located in the sub-station, where, as stated, they are subjected to a minimum exposure. The switchboards will moreover handle only comparatively low potentials. These new ideas are now being carried out right in our own immediate jurisdiction, and it is believed that the close of the present year will witness the erection of two if not three large central stations of this type in California alone.

It must be evident then that, as stated, the electric station is in a state of transition. It is also evident that electric stations as we find them to-day naturally resolve themselves, according to their construction and equipment, into the original type and the modern type. With the former, we are all too familiar, and underwriters will not soon forget the experience they have bought concerning it.

Of the modern station as a whole we have no experience, nor does it appear possible that we are likely to learn any disastrous lessons from it. It is almost too recent a creation to be able to gauge its worthiness as a fire risk by statistics, but there is not an element in its construction with which we are not perfectly familiar in one way or another. We know that a building constructed entirely of brick, iron, stone and cement will not burn; we know that a steam plant may be placed with perfect safety in such a building. We know, too, that the placing of the pile of iron and copper called a dynamo in that building will not render either it or the steam plant more combustible, neither should we believe that the addition of a frame-work of iron piping and the securing thereon even of mysterious instruments of brass, copper and slate will add to the inflammability of the rest of the premises, and even though this combination of iron piping and intricate instruments be known as an electric light switch-board.

Here permit me to reiterate one fact, and let it be recorded, even though every other be forgotten: There are two classes of electric risks—the original electric light plant and the modern electric station, and to gauge the hazard of one by that of the other is impossible.

I have to present the accompanying tables compiled from statistics received from 87 central stations on the Pacific coast:

Insurance Statistics for 1892 from 87 Electric Stations on the Pacific Coast.

Insurable Property.

Valuation of buildings	$ 749,513
Valuation of dynamos and electrical apparatus	2,051,438
Valuation of boilers, engines, etc.	1,363,334
Total insurable valuation	$4,164,285

Property Actually Insured.

Valuation of buildings	$ 584,211
Valuation of dynamos and electrical apparatus	1,379,588
Valuation of boilers, engines, etc.	1,092,609
Total insured valuation	$3,056,410
Valuation of uninsured property (or 26 per cent).	$1,107,875

Insurance.

Amount of Insurance carried	$877,471.00
Amount of premiums thereon	17,431.10
Average rate, $1 98	

Losses.

Causes of fires:	
Hot bearing	$3,000.00
General fires	350.00
Defective fire-box	100.00
Gross losses	$3,450.00
Insurance loss on above	100.00
Number of fires	4

Characteristics of Stations.

Joint Occupancies.

Planing mill	3
Flour mill	3
Saw mill	1
Gas works	1
Brick dwelling	1
Water works	1
Total	10

Power Used.

Steam	64
Water	12
Both water and steam	7
Electricity bought from other stations	5
Sub-station	1

Class of Station.

Stone	2
Brick and stone	3
Brick	33
Corrugated Iron	6
Frame	43

Exposures.

Unexposed	38
Flour Mill	4
Planing Mill	7
Dwellings and similar frame buildings	16
Saw Mills	0
Sundry Mfg. Risks	18

It is now regretted that statistics were not invited from all electric station people of the entire country instead of only from those within jurisdiction of the Pacific Insurance Union. None but those who have attempted anything of the kind appreciate the difficulty that is experienced in obtaining such statistics. It is not that the electric station people are particularly adverse to extending them, but rather that they are indifferent to the matter and do not appear to appreciate the importance of full co-operation. The effort to obtain complete statistics for the years previous to 1892 has proven so near a failure that it is not deemed advisable to present the meager returns received, but so far as central stations fires within the jurisdiction referred to are concerned, I can recall but two cases where insured stations were burned, and the insurance loss on these could hardly have exceeded $10,000. They were small small stations of the original type, and the cause of the fire in each is attributed to carelessness in permitting the wood and sawdust fuel used to accumulate near the furnace doors. An earnest endeavor will be made during the coming year to complete these statistics for the years previous to 1892, and in fact, to [illegible] figures down to date in a completed form.

Of the 180 electric stations within our jurisdiction [illegible] 87 responded, and a greater part of these returned figures for only the year 1892. The results presented are therefore confessedly incomplete, but they are offered for what they are worth. If they do no more than to show the electric station people the disposition of the made of the statistics they are asked to furnish, they will prove of value as preparatory to future papers in the same direction.

Two of the fires reported consisted in the destruction of arc lamps in general fires, while in the only insurance loss reported it was stated that $100 was paid in the losses by the insurance companies, and that the fire "occurred under the boilers." Possibly a funny man was abroad in the land the day the statistics were made out. In addition to the losses enumerated the station at Palouse City, Wash., was burned, but I have been unable to secure information concerning the losses sustained. It is noteworthy that the average rate of insurance on these stations is a trifle less than two per cent. and considering the fact further shown that the character of the stations that have responded is thoroughly varied, the average rate shown does not substantiate the cry of extortion. On the other hand, however, no complaint can be made of insurance losses on electric stations on the Pacific coast for 1892. There is still another point to be noted. The valuation of the insurable property of these 87 stations is $4,164,285; the valuation of the property actually insured is $3,056,410 and the amount of insurance carried on this is but $877,471, or about 28 per cent.—a matter which will be carefully noted by students of co-insurance.

One station manager writes: "An interesting instance of the value of a comparatively fire proof station such as ours was furnished since I last wrote you in our own station. Through the carelessness of one of our linemen we had an exceedingly bad cross upon our incandescent dynamos. The cross came in on the machines and set fire to two of them so badly that had we been in our old wooden station, with its rough and greasy floors, our entire plant would have been consumed. As it was the red hot wires with burning embers fell upon the floor and died for want of combustible material." Another station manager, whose company carries a partial insurance of $55,000, complains that the rate on their station is so "ridiculously" high when the risk is taken into consideration that principally on this account the company in building a new station, which will cost over $1,000,000, is making it absolutely fire-proof, and will carry no insurance whatever. It was a relief to receive the following, which is a solitary exception to the universal tone of complaint. The secretary of an electric light company wrote: "The amount of insurance we carry is so small that I do not feel called upon to criticise the insurance companies. They do not always repose on downy beds of ease, especially for the last year or two." Still another manager, who is part owner in several stations, writes that "the insurance people have been compelled to pay a number of heavy losses, some of them no doubt being due to electric wires, and this has apparently had the effect of making the rates high on central stations generally, regardless of their construction." He concludes by stating that the stations in which he is interested and which are now under construction are being built "in such a way that they cannot be burned and therefore will require no insurance at all." One station manager whose plant is a thoroughly modern one complains that the "general principle prejudice" against all risks is used against his station, and contends that if the rates on electric risks were made by underwriters who had a practical electrical knowledge there would be less cause for complaint. The secretary of another electric light and power company writes that both the electric light companies in his city had cancelled all insurance carried, believing that "the risk is not commensurate with the premium required under a policy where we assume a joint risk with the insuring company for any loss we may sustain. I know," he continues, "that I am voicing the sentiment of all electric people in saying that little or no fire insurance will be given under the present co-insurance requirements." Still another who is entirely satisfied with the rate imposed, but who carries no insurance on $35,000 worth of steam and electrical machinery placed in a thoroughly modern station, for the reason that his company does not believe in sharing the risk with the insurers. If they could insure under a policy containing no co-insurance clause, even at a higher rate, the property would be insured.

From the excerpts given will be noted two important conditions: First, that electrical people in erecting new stations are exerting great effort to make such stations absolutely fire proof in order to avoid carrying insurance; and, second, that general dissatisfaction exists over the insertion of the co-insurance clause in policies. I cannot but feel that the dissatisfaction now existing between electric and insurance interests in reference to rates of insurance on the risk known as the modern electric station, is due equally to errors committed by each of the two interests concerned. It is not to be questioned but that the old form of electric station is deserving of high rates. The underwriter's position in this regard is impregnable, but where he has committed his error is in failing to recognize by reduced rates new departures in station construction which have unquestionably increased the safety of the plant. The underwriter is slow to forget his losses on electric light plants, and these were so severe that he fails to realize that there are electric stations and electric stations. This has led electric interests to erect their stations so as to be as near fire proof as possible, with the idea of carrying their own insurance. Electricians should bear in mind, however, that nothing is absolutely fire proof

and that no ordinary business can afford to carry its own fire risk.

On the other hand electrical people are quite in error in the contention that co-insurance is an unreasonable exaction, and that, to express their ideas plainly, it is a means of extortion. Such views are entirely wrong and certainly equity in levying rates can be attained only through the plan of co-insurance. To describe the details of its workings is not within the scope of this paper, particularly in view of the fact that pamphlets describing it more fully than I am capable of doing are issued by insurance organizations. This much may be stated, and that is, only by co-insurance can perfect equity be attained. The plan is practiced exclusively in all marine underwriting, and in many European countries, and it is in recognition of the dissatisfaction which is prevalent in electric stations that underwriters are making recourse to the plan of co-insurance for a solution of the difficulty.

The existing situation between insurance and electric interests may be summed up as follows: The electrical fraternity, forgetful of the injury it has inflicted upon underwriters, is thoroughly dissatisfied with the present rates and methods of insurance procedure and is devoting every energy to eliminate the hazards of the business with the idea of carrying its own insurance. On the other hand the underwriters, smarting under the losses they have borne, fail to recognize the improvements that have been made in electrical construction. This you must do or some day it will transpire that electric stations have placed themselves generally beyond the necessity of insurance. Whether the idea is tenable or not, it is the one now held by electrical people the country over, and as such it demands your consideration.

Panel Distributing Board.

An improved method for controlling the distribution of current in buildings, which would take the place of a number of cumbersome porcelain cut-outs, has long been a desideratum with construction and wiring men. An aggregation of separate cut-outs enclosed in a cupboard, and hidden from sight in some secluded portion of the building, hard to get at and difficult to manipulate, has long been considered antiquated, but the hour of deliverance has only just sounded. It has remained for the inventive talent at the command of the General Electric company to invent a system which not only does away with the porcelain link or plug cut-outs when used as distribution centers for a number of circuits, but substitutes a handsome device fulfilling all the functions necessary.

Fig. 1 shows one of these panel distribution boards, arranged for the distribution of current for 120 lights from a three-wire main service over twelve circuits on a two-wire system. The panel itself is a polished white marble slab ten inches by twenty inches. The main wires are brought to the lugs and are continued along the front of the panel in the shape of flat hard drawn copper rods. Upon these are mounted stiff spring copper clips. Each main wire and each side of each branch circuit is protected by a fuse enclosed in a porcelain box of novel design, from the sides of which project short flat blades of copper. By means of these blades the fuse carrier is inserted in position and is there securely held by the copper clips. A perfect frictional contact is thus insured.

The construction of the fuse carrier is peculiar. It is literally a box with three sides straight and one arched, having a partition in the center between the two terminals to which the fuse is fastened, as shown in Fig. 2. When compared with the time honored screw plug or ordinary fuse its advantages are obvious. No short circuit can possibly occur between the terminals; the arc cannot fuse the fused metal and burn them out; the molten metal cannot be blown out, the mica lined cover preventing this, the area of contact is considerably greater than in the case of the screw fusible plug, and in replacing a blown fuse the wireman is not exposed to any danger from a sudden blow of the new fuse. A fuse carrier can be removed and the fuse replaced on the spot, or a fresh one can be inserted, and that in which the fuse has blown can be carried away and the fuse replaced at the repair shop or the works. The removal of a fuse carrier, with fuse, of course disconnects the circuits.

All connections are made upon the face of the panel. This disposition enables it to be fastened against a wall or to be be sunk in a recess bringing its surface flush with with the wall, a glass door hinged to a polished wooden frame serving to protect it from the merely inquisitive. This style of panel distribution board can be made up in almost any combination circuits, and can be placed almost anywhere in any building, its handsome appearance detracting in no wise from any surrounding decoration. The new Waldorf Hotel in New York is the first building to be fully equipped with these panels, no less than 3 500 lights being distributed from a number of them.

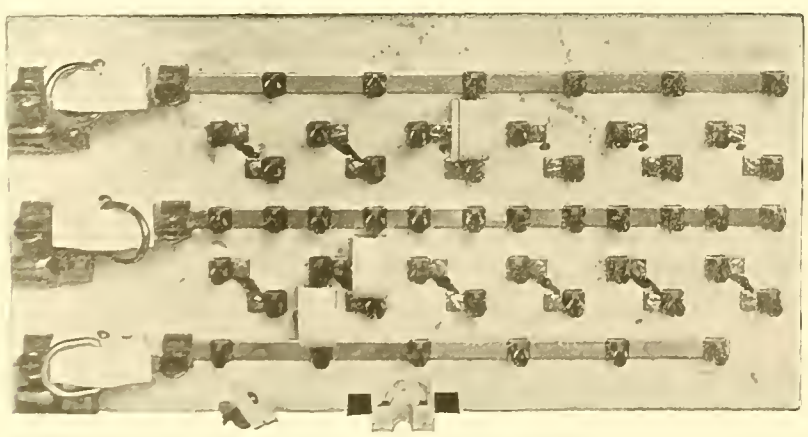


FIG. 1. PANEL DISTRIBUTING BOARD.

The Detroit Plating Dynamo.

The accompanying cut illustrates the improved King dynamo which was specially designed by the Detroit Dynamo company of Detroit, Mich., for electroplating, electrotyping and copper refining purposes. This new form of machine the company believes to be a great improvement over the old type. The new machine has a zinc subbase between the pole pieces and the iron base. The commutator is screwed on; and, by making it detachable in this way, a new commutator can be put in place in a few minutes, and it is not necessary to return the entire armature to the factory when commutator repairs are necessary. Commutators for these machines are made from the Eureka Tempered Copper company's segments. Following are a few of the claims made by the company for this machine which will be appreciated by electroplaters: There is no reversal of current or sparking on the commutator or detrimental heating of fields or armature.

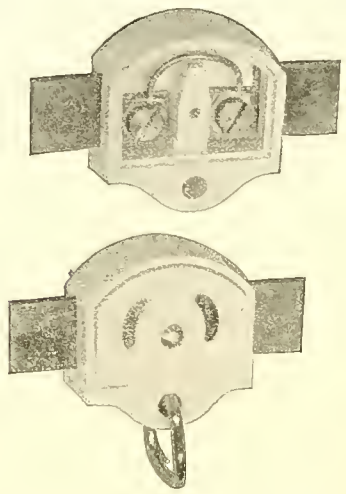


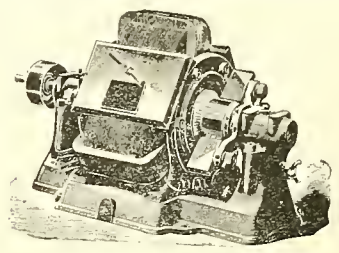
FIG. 2. PANEL DISTRIBUTING BOARD.

This dynamo, the company states, will maintain a perfectly steady voltage whether running under a light load or working up to its full capacity. The Detroit Dynamo company states further that the metal deposited by the machine is not so hard to buff, making more lasting deposit and buffing up with a fine rich color. An especial point is made to the effect that this machine will deposit a good shell in two hours.

The Rochester Railway company, with its usual progressiveness, is testing electric heaters for use in its cars.

Dahl's Alternating Current Motor.

In the accompanying cut is shown a one horse power alternating current motor invented by Olof Dahl and placed on the market by the Dahl Electric company, New York. These motors can be made any size, from one horse power upward. They are synchronous, and are self excited, starting themselves vigorously with a torque about equal to their normal capacity. They have a commercial efficiency of 75 per cent. for one horse power, and increase with the size of the motor up to over 90 per cent. There is no undue heating in any of the parts, and neither armature nor field

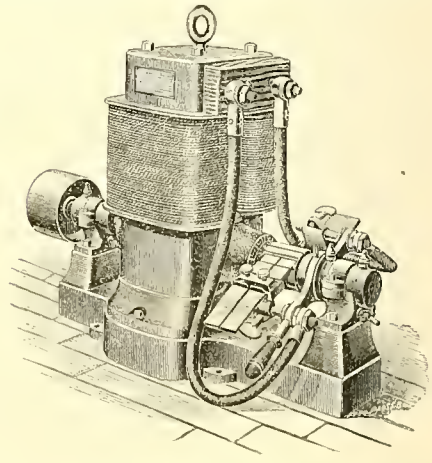


DAHL'S ALTERNATING CURRENT MOTOR.

coils rise in temperature more than 30 deg. above the surrounding atmosphere under normal load, and there is no heating of the field cores. Should this armature be stalled (and this does not occur till the motor has fifty per cent. overload) the armature will not be injured, and no serious heating of the coils will take place, the current being choked back by the self-induction. This motor is designed to operate on the alternating system in use at the present time, without any reduction in the number of alternations, which is called for in the use of the multiphase, involving as it would more expensive transformers, greater in weight proportional to the reduction of alternations.

Ries' Improved Regulating Socket.

In the accompanying cut is shown an inside view of the improved regulating socket for incandescent lamps, manufactured by the Ries Electric Specialty company of Baltimore, Md. This socket has already been illustrated in these columns and the general principle upon which it is constructed explained, but there have been several important improvements in the device since its introduction. In



THE DETROIT PLATING DYNAMO.

its present form, as shown in the cut, the socket comprises among other things the base or lamp-holding portion proper, the reaction coil by means of which the opposing or regulating counter electromotive force is generated, the insulating block or support containing the contacts representing the coil terminals, the operating key, switch arm and binding screw connections for the leading in wires, and the inclosing shell, which is made in two separable parts. The old form of supporting block made of wood has been discarded and one of porcelain substituted. The reaction coil used in this socket consists of a small finely laminated annular iron core 1¼ inches wide and ¾ inch high, built up of very thin, specially treated iron rings, carefully assembled and taped. This core is wound by hand with a silk insulated cable composed of seven separately insulated copper wires varying from one another in size according to the maximum current that each is required to carry, the wires being of different colors to facilitate their proper connection. The ends of this cable, after it is wound upon the core, are then bared, and the extremities of the individual wires, each with part of its insulation removed, are threaded through a double series of holes in the porcelain supporting block in such a manner that when the copper contact or terminal pins are driven home and clinched at

the back of the block all of the several wires of the cable are connected in series, the winding being divided by the contact pins into seven sections of equal length. The operating key, which has its bearing in the porcelain block and projects through an opening in the inclosing shell, is provided with a contact arm that moves over the series of terminal pins on the working face of the block, and by including a fewer or greater number of the coil sections in the lamp filament circuit diminishes or increases the counter electromotive force developed by the coil, and thus raises or lowers the light. The operating key moves through an angle of 90 degrees, and its position indicates the extent to which the lamp is turned on. The contact

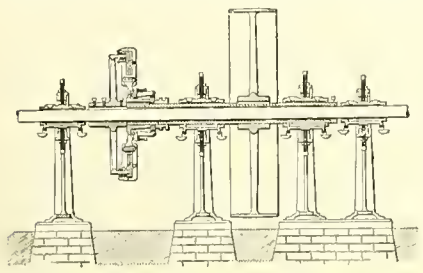


FIG. 1. PULLEY STANDS AND FRICTION CLUTCH PULLEYS.

pins are slightly depressed below the hardened glazed face of the porcelain block, so as to form a seat for the end of the contact arm, and thus insure its proper electrical engagement with the pins and prevent accidental displacement. Another improvement in the device is in the adoption of a universal socket, which is adapted to the leading makes of lamps. In this new form the center contact is a hollow slotted stud provided with the standard Thomson-Houston lamp thread upon its outer surface, its interior being of the proper diameter to receive the center pin of the standard Sawyer-Man or Westinghouse lamp, while its exposed end is arranged to bear against the center disk of the standard Edison lamp base. The slots in the projecting portion of the center stud give it sufficient elasticity to make good electrical contact, and to accommodate itself readily to variations in the diameter of the contact pins or threads that are often found in lamps of different makes. It is also capable of a slight vertical movement to accommodate variations in lamp bases. The stud is of square cross section where it enters the porcelain washer, and has a milled end that fits into a rectangular opening in the stem of the porcelain insulating block that passes through the center of the reaction coil, thus effectively locking the stud and preventing it or the washer from turning.

In this connection it may be said that the use of this socket is not confined to central station plants, but is being quite generally adopted in isolated work in which low tension alternating current generators supply the current without the employment of converters.

Pulley Stands and Friction Clutch Pulleys.

In the accompanying cuts are illustrated some mechanical improvements devised by P. Pryibil of 546 West 41st street, New York city, which will interest central station

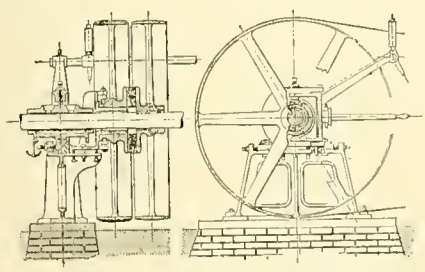


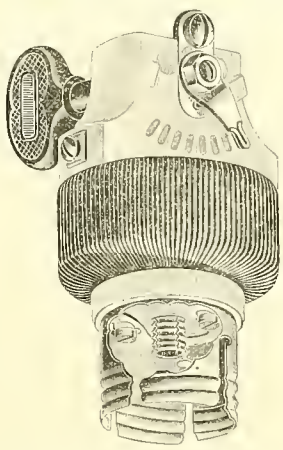
FIG. 2. PULLEY STANDS AND FRICTION CLUTCH PULLEYS.

men. In Fig. 1 is shown a loose pulley stand as arranged for driving dynamos. It is applicable to other machinery which stands at rest part of the time, while the shaft remains in motion. When either a plain friction pulley or an ordinary loose pulley is used for this purpose, the hub wears loose on the shaft, power is consumed and constant care is required to keep it properly oiled and prevent heating and cutting. With the arrangement shown the loose pulley remains at rest on a fixed bracket, except while the belt is being shifted either on or off. The loose pulley therefore requires hardly any attention and the shaft is entirely relieved from belt strain, when it ceases to drive the machine. To get the belt in motion so as to shift it off of the loose pulley, the latter is forced over, by a hand lever, into contact with a friction disk attached to the fast pulley on the shaft. As soon as the belt is on the fast pulley the loose pulley is again allowed to come to rest.

In Fig. 2 is shown an arrangement that consists of a quill encircling the shaft and carrying the pulley and the friction clutch. This quill does not touch the shaft but is carried by independent, self oiling, adjustable bearings. The device is especially recommended for dynamos and for other machinery which has to remain at rest part of the time while the shaft revolves.

Two New Switches.

In the accompanying cuts are illustrated two new switches placed on the market by the General Electric company. Fig. 1 shows a snap switch, the distinguishing feature of which is the ratchet piece, which has four steps arranged in quadrants on both the upper and lower sides and revolves horizontally. One of these ratchet steps is covered with a copper strip passing across the porcelain to the corresponding steps on the other side of the ratchet block. Two contact strips of hard spring copper, placed opposite to each other top and bottom on either side, bear upon the copper pieces on the ratchet when the circuit is completed. When the ratchet is revolved, the copper spring pieces are slowly forced apart until the crest of the steps is reached, when they spring to the uncovered steps or quadrants instantaneously, making arcing impossible, and placing between them a barrier of porcelain insulation. A similarly forward movement instantaneously makes the circuit. The arrangement is similar to that in the ordinary plug switch, in which a solid mass of metal is inserted between contacts, and the circuit broken by its removal. In this switch the metal plug is withdrawn and instantaneously replaced by



RIES' IMPROVED REGULATING SOCKET.

a porcelain plug. By the peculiar formation of the ratchet and the length of the copper brushes it has been found that the latter do not acquire a permanent set, even after long use. These switches are made in the double pole variety only, and are of two patterns, the ordinary type, and the flush pocket style. The latter is adaptive to insertion in wall pockets, and is then furnished with a decorative wall plate. These switches are designed in capacities of 10, 25, 40 and 50 amperes.

In the switch shown in Fig. 2, instead of a blade descending jack-knife-wise into receiving clips on a slate base, the solid contacts are rigidly mounted on the base, and the clips operated by the handle come down one on each side of the contact piece. The soldering of the clips into the lugs is done away with, the lug and contact pieces being one homogeneous piece. The parallel clips are hinged to one contact piece, and are also securely riveted to a piece of metal half way between the hinge and making end. To this piece is fastened the handle, which projects upward and then forward at an angle of about 45 degrees. The characteristic feature of this switch is an almost perfect contact surface, having a low co-efficient of friction, with high conductivity. A new method of breaking the circuit has been introduced in this switch. It consists of a short brass bar fastened on the under side of the switch blades, one end pivoted near the middle of the blades, the other being held by a spiral spring, while on the side of the contact post facing the hinge of the switch is a small projection. As the switch is opened, the end of the small bar catches on this projection, and thus remains in full contact until after the blades have entirely left the contact post. When the switch is well opened, the bar slips off the contact post, and is drawn by the spring to its original position against the blades of the switch. These switches are designed for use on circuits of a potential not exceeding 500 volts, and are made in capacities running from 30 to 1,500 amperes.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 11.—The Rapid Transit commission has at last announced its decision in the matter of the application of the Manhattan Elevated Railway company for extending the road and increasing the carrying capacity of the present lines, but at best the arrangement is only a temporary makeshift and by no means solves the problem of securing rapid transit for the city. Some of the applications of the "L" company have been refused, others have been granted and more have not been determined. The

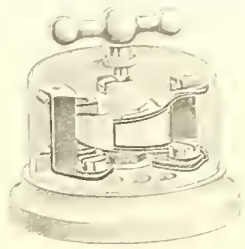


FIG. 1. TWO NEW SWITCHES.

report as a whole may be considered favorable to the company and a practical surrender to the powerful corporation. Little else could have been expected after the failure of the commission to enlist public interest and secure private capital for the building of an underground system. One of the grants which the commissioners made will be received with interest by the electrical fraternity, though it must be admitted that there is little reason to hope that the company will take advantage of the right to introduce electric motors: "The application for authority to use independent motors to be operated by either steam, electricity or compressed air for the movement of trains is hereby improved." All of the proposed extensions and improvements must be completed within two years of the granting of this franchise by the city.

A proposition to establish another system of elevated roads and sell the franchise at public auction was tabled. Mr. Spencer presented an application for granting the Manhattan company additional privileges similar to those proposed in the scheme for an independent system, but this was also tabled for further consideration. To sum up the situation, it may be said that the work of the commission makes provision for temporary advantages only so far as the public is concerned. The prospect for extending the lines and increasing the capacity of the present system may afford temporary relief, but there is absolutely no reason to consider it a permanent solution of the great problem. This fact is recognized by every man in New York who has had an opportunity to consider the subject in all its bearings.

The Telephone Subscribers' association of the state of New York mailed a memorial to the members of the senate in Albany Thursday night, asking for immediate and favorable action on senate bill No. 237, which calls for the creation in this city of a board of telephone commission-

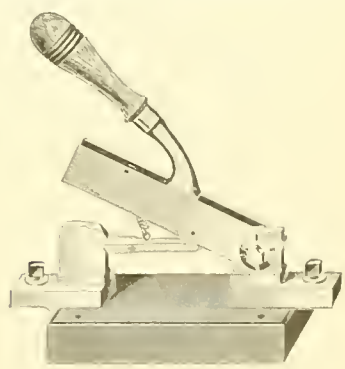


FIG. 2. TWO NEW SWITCHES.

ers. This bill passed the senate last year but failed in the assembly, and it is now in the hands of the committee on miscellaneous corporations. Silas M. Giddings introduced a similar petition at the meeting of the New York Board of Trade and Transportation on the same day and it was unanimously adopted. It showed that the charge for telephone service in this city when first introduced was only $60 per year, the rate being then regulated by competition but consolidation of the competing companies enabled the Bell company to advance the rate to $90, then to $150 and $180, and now to $240, which is the highest rental paid by any city in the world. The resolutions say: The pretense that with a larger number of subscribers the cost increases per capita to the company was proven false by

the testimony of the officers of the company before the Ainsworth investigating committee, and there is no excuse for the added advance from $150 to $240 on the ground of added cost by reason of the subways.

More than three years ago the State Electric Light & Power company presented a petition to the board of aldermen of Brooklyn asking permission to string wires and supply electricity, but the political bosses, who already own and operate an electric light plant, will not permit it to do so. Its applications have been referred to a committee with great regularity, and the committee never meets. Now the new company has added an offer of $10,000 in cash for the coveted franchise. It has offered to furnish lights to the city at 40 cents a night, instead of fifty cents, charged by the old company, and to save the city over $100,000, but the application has been promply buried in that same old committee. The reason for this condition may possibly be found in the list of the officers of the old company, which is as follows: President, Hugh McLaughlin; secretary, James Shevlin; treasurer, Thomas F. Nevins.

Governor Werts of New Jersey has nominated George R. Gray for electrical subway commissioner to succeed James Smith, Jr., resigned.

Five thousand eight hundred feet of wire belonging to the United Electric Light & Power company has been stolen from poles and the "L" road since February 17th. The thefts have been mostly on Church street, between Cortlandt and Chambers streets, and on Washington and Cedar streets.

The Third Avenue Railroad company has asked permission of the board of aldermen to add nine miles more of tracks. It already has fourteen miles. It is believed that the company will introduce the trolley system. Action has been postponed until March 21st.

The Edison Electric Illuminating company of this city held its annual meeting on Thursday. Trustees were elected for the ensuing year as follows: C. A. Coffin, Charles H. Coster, Thomas A. Edison, S. D. Greene, J. Hobart Herrick, Edward H. Johnson, Arnold Marcus, Carl Schurz, Francis S. Smithers, Samuel Spencer and J. Hood Wright. The Edison Electric Illuminating company proposes to issue $3,000,000 additional stock, as $2,250,000 will be required to retire its outstanding bonds. The remaining $750,000 will be used during the year for the development of the business of the company, and when so used may be issued to the stockholders, probably at par.

The Sawyer-Man Electric company filed a notice of voluntary dissolution yesterday with Judge Ingraham of the Supreme Court. The court set June 12th to hear the objections of any persons who may want to oppose the dissolution. The petition says that the company has no liabilities and only $4.60 of assets.

W. F. O.

Milwaukee, Wis.

MILWAUKEE, March 11.—The most formidable legislation ever directed against the street railway companies of the city is embodied in an ordinance introduced at the last meeting of the common council. It requires the companies, on the first of August of each year, to make a statement to the city treasurer of the gross earnings for the fiscal year ending June 30th. The most important provision of the ordinance requires the companies to pay 2 per cent. of their gross earnings into the city treasury, in lieu of all license fees. A failure to comply with the provisions of the ordinance will be punished by the forfeiture of $10,000.

At a recent meeting of the council committee on railroads Henry C. Payne and Attorney Henry J. Killilea appeared in behalf of the company. Mr. Payne opposed the proposed ordinance requiring the company to furnish passengers tickets good for another ride whenever a car is delayed more than four minutes. He intimated that if a disposition were shown to harass the company, it could retaliate by shortening its lines and collecting two fares for carrying passengers over what is now the National avenue line. A delegation of prominent business men has investigated the matter and has come to the conclusion that the company is doing all in its power to give good service. The company intends to spend $2,000,000 more in Milwaukee, and the business men declare that it would be unwise and unjust to harass it now.

At the meeting of the committee on railroads just prior to the last session of the Common Council a committee of citizens made an earnest plea in behalf of the Villard syndicate. The business men were C. M. Cottrill, E. B. Hopkins, [illegible] C. Rogers and Patrick Cudahy. They acknowledged that the public had been inconvenienced at times, but said that the cars were the company's misfortune rather than its fault. Enough cars to accomodate the public were not operated because the fire at the South Side barns had destroyed many of the cars. The delays in filling contracts for machinery were alluded to. The erection by the E. P. Allis company of a temporary power plant was mentioned and reference was made to the contracts with the Filer-Stowell people. On the latter contract the first order was due December 24, 1892, and the other January 24, 1893, and although the contracts provided for heavy penalties in case of delay, it did not look as though the machinery would be in place in two months. The main power plant, however, can now keep four engines in reserve, as a result of the building of the Allis temporary power house. As to the trouble caused by the weather, it was said that electric lines in other large cities had suffered as much from the recent snow blockades as the Milwaukee lines had. The business men also called attention to the fact that the Villard company had invested between $7,000,000 and $8,000,000 in Milwaukee, and they made an earnest appeal in its behalf for fair treatment. They alluded to the timidity of capital and to the necessity of running the municipal government on a broad-gauged basis.

The employes of the Wisconsin Telephone company have organized a mutual aid society. The society includes every person connected with the company, from the president down. It will furnish physicians, pay sick benefits and pay a certain sum at death. It has been named the Telephone Employes' Mutual Aid society. The officers for the first year are as follows: President, F. W. Smith; vice-president, Q. Jansen; secretary, W. H. Hyde; directors, Miss Libbie Faust, Miss Kittie McManus, John Leidigh, John E. Reilly and John E. McKivatt.

Quite a large audience attended the first lecture, by Prof. Warren S. Johnson, of the People's Institute course in electricity. The talk was illustrated and it was devoted to explaining the fundamental principles of electricity.

New England Notes.

BOSTON, March 11.—The last decision in the incandescent lamp litigation confirmed the victory of the Edison interests, being in the same line as former decisions. Judge Colt has denied the application of the Beacon company for a stay of proceedings, pending the determination of an appeal from the preliminary injunction recently granted the Edison interests. This decision was handed down on March 7th.

Progress in the development and extension of electric railways in New England has received a serious set-back through the combined efforts of the steam railroad companies, which have determined to oppose further grants. In Connecticut General Manager Tuttle, of the New York, New Haven & Hartford Railroad company is the moving spirit in this fight. The powerful corporation which Mr. Tuttle represents is credited with great influence in the state Legislature; in fact, that body seems to be under the control of the railroad, and any legislation favored by it receives immediate attention. It is announced that the railroad combination has agreed upon a bill to be presented to the Legislature regulating electric roads. The railroad magnates have decided that no further privileges shall be granted the electric companies. If any doubt existed in the minds of the people of the vast power of the railroad companies, it would at once be satisfied with this announcement of the state railroad commission in its annual report:

The desires of suburban land owners who wish to see their fields and pastures converted into accessible house lots, and the purposes of owners of electrical patents and manufacturers of electrical machinery whose business it is to equip street railways, as well as the rapid growth of some of the larger towns, are potent factors in the extension of our street roads and the increase of the volume of their business. In New Hampshire, as in other states, electricity is being substituted for horse power upon street roads, and whenever it is done the next step is to extend the tracks to neighboring towns and compete for passenger business that has been controlled by steam roads, because, while it does not pay to haul cars by horse power over long stretches of unsettled territory in order to reach a village or pleasure resort, this can profitably be done by electricity after an electric plant has been established. Of the five street railways in this state two now use electricity as motive power, and both parallel broad gauge roads, the Dover, between that city and Great Falls, and the Concord, between that city and Penacook. It is proposed in the near future to equip the Manchester road with electrical appliances, and extend it east to Lake Massabesic and south to the city boundary, side by side with the steam roads, and similar changes are looked for at Nashua. Indeed, it is confidently predicted that by a union of existing street roads, the procurement of a few charters covering links now missing, and the construction of such links, we shall soon have a continuous electric road following the highway from Lowell to Franklin, and dividing with steam roads the passenger traffic.

Such an enterprise would be a wide departure from the objects that were sought to be accomplished by the chartering and building of street railways, which were originally designed merely to facilitate street travel from one part of the city to another, and were given rights and privileges far beyond what were granted long distance roads; and while it might afford the traveling public desirable convenience and rates, before this or any similar project is approved, it is well to ask whether it does not threaten the rights of others and subject people generally to burdens which they will desire to be rid of later on.

A steam railroad corporation, whose business it is to carry passengers from one town to another, is required to buy its right of way, construct and maintain its road bed, bridges and fences, and provide suitable depots and crossings. Can any good reason be given why an electric road corporation, whose business is exactly the same, should be given a roadway and furnished with a roadbed, bridges and fences at the public expense, and thus given a great advantage over its competitor, and allowed to subject citizens, who are taxed to support and have occasion to use our highways, to constant annoyance, risk and expense? We think not. If electric roads are to do a general railroad business for the pecuniary benefit of their owners, we see no reason why they should not be subject to all the requirements that are imposed upon other roads doing exactly the same business, or why they should be given exclusive and very valuable rights and privileges in the highways to the discomfort and damage of the public; and before it is too late we hope to see established in New Hampshire the rule that all railroads that are designed to do a through business from one town to another shall keep out of the public thoroughfares, pay for the land they occupy, and build their own bridges, fences and stations.

This opposition of the steam railroad companies is not confined to Connecticut. In New Hampshire the Boston & Maine and the Concord & Montreal roads have succeeded so far in preventing the passage of any bills granting franchises to electric roads. This they have done in order to prevent the building of new roads and union of old ones to form a direct line from the New Hampshire summer resorts to the Massachusetts beaches, the scheme which has already been outlined in the WESTERN ELECTRICIAN. The railroad committee of the house has reported a joint resolution as follows:

Resolved, That the railroad commissioners be requested and instructed to examine and make due inquiry and report to the next session of the General Court, by bill, special report, or both, what legislation, if any, the public good requires in reference to the powers to be conferred upon or exercised by railroads operated by other than steam power, and that, pending such examination and until such report is received by the General Court, all bills providing for the incorporation of such railroads or enlarging the powers of those already chartered, shall lie upon the table or be postponed until the next session of the General Court, except in cases where additional legislation, with reference to existing and new charters, may be clearly demanded to subserve the public interests.

It has been generally reported that the Boston & Maine Railroad company would make a trial of an electric locomotive on its Crescent Beach line. This is incorrect, though it is true that such a trial is to be made by the General Electric company. The company has given permission for the use of the line for experimental purposes The overhead trolley system will be used. Power will come from the Lynn works of the General Electric company, and the electrical equipment of the line will be finished in about two months. Both freight and passenger cars will be hauled over a loop about four miles long.

J. C. E.

PERSONAL.

Albert Scheible has just returned from a two weeks vacation.

George M. Phelps of the *Electrical Engineer*, New York, was in Chicago last week.

A. W. Reppy, agent for the Pullman company, passed through Chicago last week on his way to Washington, D.C.

J. H. Rhotehamel, president of the Columbia Incandescent Lamp company of St. Louis, has been spending several days in Chicago.

G. F. Koch, superintendent of the Falls City Electric Construction company, Louisville, Ky., was a visitor to the World's Fair city last week.

I. Paul Gaylord, president of the Pennsylvania Electric Engineering company, and Louis P. Shultz, treasurer of the same company, were in Chicago last week.

R. Eickemeyer of Eickemeyer & Osterheld Manufacturing company of Yonkers, N. Y., is in El Paso, Tex., for his health, where he will remain until the middle of April.

Edward F. Seixas of the Chicago & St. Louis Electric Railroad company will leave for Europe March 18th on the Werra. Mr. Seixas goes abroad to look after certain electrical interests.

W. M. Stine has been elected director of the department of electricity of the Armour Institute, Chicago. He is 28 years of age. In 1886 the degree of A. B. was conferred upon him at Dickinson College, where he won the highest honors in science. He remained there as tutor for one year. In 1886 he was made assistant professor of chemistry

and physics in the Ohio State University, and the next year was given the professorship of that department, which place he held until 1892.

Chas. B. Steinmetz, formerly connected with the Eickemeyer & Osterheld Manufacturing company of Yonkers, N. Y., as electrical engineer, has accepted an important position with the General Electric company, and will be located hereafter at Lynn, Mass.

The death of Prof. Stefan of Vienna has just been announced. He had been a voluminous writer on electrical subjects. In 1883 he was chairman of the committee on experiments of the electrical exposition in Vienna, and at the time of his death he was professor of physics in the University of Vienna.

Francois Van Rysselberghe, the noted Belgian electrical engineer, recently died at Brussels. Although his name has been associated with telephony and telegraphy, he had lately attracted attention in the electrical world as a promoter and defender of the hydro-electric system, which is now being installed in Antwerp.

W. S. Andrews has resigned his position as general superintendent of the works of the Canadian General Electric company, at Peterborough, Ont., to assume the management of several large electric light and power concerns in Pennsylvania. His experience in this business dates from 1883, when, in connection with Frank J. Sprague, he put in the first Edison three-wire central station plant at Sunbury, Pa., and since that time several Edison light stations have been installed and started under his supervision, among which may be mentioned Harrisburg, Williamsport and Lancaster, Pa.; Rochester, N. Y.; New Orleans, La.; Chicago, Ill., and Minneapolis, Minn. Mr. Andrews became associated with Mr. Edison at Menlo Park in 1879, and has since that date been intimately and constantly connected with the manufacture, installation and operation of electric light and power machinery.

NEW INCORPORATIONS.

Wichita Electric Railway & Light company, Wichita, Kan.; capital stock, $450,000; to operate a street railway and electric light plant.

Jefferson Electric company, Jefferson, Wis.; capital stock, $20,000; operating an electric light plant; George Grimm, Jefferson, Wis.

Anthony Electric Light & Power company, Anthony, Kan.; capital stock, $15,000; to manufacture and furnish electric light, power and heat.

Miami Light & Power company, Kansas City, Kan.; capital stock, $40,000; to construct and operate electric light plants and electric street railways.

Marshall Electric Light & Power company, Marshall, Mo.; capital stock, $30,000; light and power; Macon Gas & Electric Light company, Macon, Mo.

Electric Power & Storage company, Ashland, Wis.; capital stock, $100,000; manufacturing and selling storage batteries, electric heaters, etc.; J. S. Ellis, Ashland, Wis.

Brinton Park Street Railway company, New Castle, Pa.; capital stock, $20,000; constructing and operating an electric railway in New Castle, Pa.; R. B. McComb, New Castle, Pa.

Middletown Electric Railway company, Middletown, Pa.; capital stock, $100,000; constructing and operating an electric railway in Dauphin county, Pa.; John W. Rife, Middletown, Pa.

Pittston Suburban Passenger Railway company, Pittston, Pa.; capital stock, $90,000; constructing and operating an electric railway in Luzerne county; Louis A. Watrous, Scranton, Pa.

Clayton Electric company (incorporated in West Virginia), Pittsburg, Pa.; capital stock, $50,000; manufacturing all devices connected or used with electricity; B. S. Patterson, Pittsburg, Pa.

Cambridge & Edinboro Street Railway company, Edinboro, Pa.; capital stock $50,000; constructing and operating an electric railway in Erie county; Lyon, McKee & Sanderson, Pittsburg, Pa.

American Armature company, Portland, Me.; capital stock, $50,000; to manufacture and deal in armatures, transformers, electrical devices and supplies; Benjamin Thompson, Portland, Me.

Union Electric Light & Power company, Waterford, N. Y.; capital stock, $150,000; consolidation of the Union Electric Light & Power company with the Waterford Electric Light & Power company.

Royersford & Spring City Street Railway company, Royersford, Pa.; capital stock, $12,000; constructing and operating an electric railway in Montgomery county, Pa.; G. Mortimer Lewis, Wilkesbarre, Pa.

Pen Argyl, Bangor & Water Gap Electric Railway company, Sunbury, Pa.; capital stock, $300 000; constructing and operating an electric railway in Northumberland county; C. M. Clement, Sunbury, Pa.

Citizens' Electric Railway Company of Pottsville, Pa., Pottsville, Pa.; capital stock, $200,000; constructing and operating an electric railway in Pottsville, Schuylkill county, Pa; J. H. Zerbey, Pottsville, Pa.

Citizens' Electric Power & Street Railway company, San Antonio, Tex.; capital stock, $600,000; to construct, maintain and operate an electric street railway in San Antonio, Tex.; to erect, establish, maintain and operate an electric lighting and power station and distribute electric power and furnish light to inhabitants of the city of San Antonio; Barnard McGown, San Antonio, Tex.

Somerset Lighting company, Somerville, N. J; capital stock, $100,000; to manufacture and generate gas and electric currents and transmit the same by means of pipes, wires, etc.; James L. Griggs, Somerville, N. J.

Wellston Belt & Street Railway company, Wellston, O.; capital stock, $10,000; constructing and operating street railways in Wellston and vicinity, to be operated by electric or other motive power; Harvey Wells, Wellston, O.

Springfield, Jacksonville & Winchester Electric Railway company, Springfield, Ill.; capital stock, $1,000,000; to operate an electric railway from Springfield to Winchester, Scott county, to and through Jacksonville, Morgan county, Ill.

Lake Superior Fuel Gas company, Chicago, Ill.; capital stock, $3,000,000; to manufacture and sell fuel and illuminating gas, operate plants for electric light, heat and power, etc.; Dabus & Langworthy, 115 Dearborn street, Chicago, Ill.

Lancaster Traction company, Lancaster, Pa.; capital stock, $25,000; constructing and operating motors and cables, or other machinery for supplying motive power to passenger railways, etc.; John A. Coyle, 110 East King street, Lancaster, Pa.

Pacific Sanders Electric Light & Manufacturing company, San Francisco, Cal.; capital stock, $500,000; to manufacture and deal in carbons and lamps for electric lighting and electric machinery and supplies of all kinds; A. White, San Francisco, Cal.

Chicago & Grand Marais Investment company, Chicago, Ill; capital stock, $500,000; to develop and operate timber, stone and mineral lands, erect and operate gas, water, electric light and power plants, etc., etc.; E. G. Lancaster, 701 Tacoma building, Chicago, Ill.

Columbia Traction company, Columbia, Pa; capital stock, $10,000; constructing and operating motors and cables, or other machinery for supplying motive power to passenger railways and the necessary apparatus for supplying the same; John A. Coyle, Lancaster, Pa.

Columbus Central Railway company, Columbus, O.; capital stock, $1,500,000; constructing and operating street railways in Columbus and Westerville, to be operated by electric or other motive power, furnishing electric light and power, etc.; Merrick & Tompkins, Columbus, O.

People's Traction company, Philadelphia, Pa.; capital stock, $5,000,000; constructing and operating motors and cables, or other machinery for supplying motive power to passenger railways and the necessary apparatus for applying the same, etc.; R. C. Dale, 320 Bullitt building, Philadelphia, Pa.

Reading Traction company, Reading, Pa.; capital stock, $100,000; constructing and operating motors and cables, electrical appliances and other machinery for supplying motive power to passenger railways and the necessary apparatus for applying the same; C. H. Schaeffer, 524 Washington street, Reading, Pa.

ELECTRIC LIGHTING.

The Rutherford, N. J., Electric Light company will begin action against Abram Ackerman of Woodridge for $500 damages. For five months the company has been prevented by Ackerman from connecting its wires to serve Hasbrouck Heights with public and private electric lights, although its wires were up and dwellings connected for that purpose. Ackerman's land is so situated at a turn in the public road from Rutherford to Hasbrouck Heights that the wires must cross or make a long and expensive detour. He has persistently refused to permit the erection of poles on his land, but the company succeeded in planting three poles and stretching its wires. The current was turned on and Hasbrouck Heights was illuminated in celebration of the triumph. In the midst of festivities the lights went out. It was soon learned that Ackerman had levelled the poles on his property. The company could not even recover its poles which were on Ackerman's grounds. It is said that Ackerman wants more money than the company is willing to pay for right of way.

ELECTRIC RAILWAYS.

The people of Whitewater, Wis., are talking of an electric line from Jefferson to Whitewater.

The Wauwatosa, Wis., Street Railway company, with a capital stock of $25,000. has been incorporated by August Richter, Jr., Joseph P. Schubert and Adolph C. Dick. The company will build an electric line.

The Great Western Manufacturing company has secured an order for two direct coupled slow speed generators from the Patton Electric Manufacturing company. These generators are to be used on the cars to run from Pullman to the World's Fair.

Residents of Sixty-first street in Chicago made a raid last week on the poles and overhead wires in course of erection by the South Chicago City Railway company. Many of the wires were cut and some of the poles torn down. Property-owners claim that the company has erected its poles twelve inches within the curb line, allowing only four feet for sidewalk. Besides executing summary justice on the company, a delegation of residents called on Street Superintendent Burke and asked him to revoke the permit. He visited the line of road and decided that the complaint was well founded. The permit was accordingly revoked. The road extends along Sixty-first street and South Park court to the World's Fair grounds.

The policy of the New York, New Haven & Hartford Railroad company concerning the electric roads which it has petitioned the Connecticut Legislature in large numbers for charter rights, was the subject of an interesting conference in Hartford recently. Lawyers from different parts of the state, who represent the electric systems, met the counsel of the Consolidated road to consult as to the position toward its electric competitors. The mayors of cities in the state have formulated a bill for the regulation and control of the electric roads. The New York company outlined its attitude in general toward the electrics, and a bill will be prepared, meeting the approval of the steam and electric railway managers and the municipal authorities in the state. The Consolidated company will not oppose the construction of electric lines for the accommodation of cities and towns or the development of inland communities, but it will oppose the paralleling of steam railroad lines. The Waterbury Electric Railway company for instance, which will parallel the Naugatuck for miles, will be opposed by the railroad corporation.

TELEPHONE.

The original Bell telephone patent expired on March 7th.

A new use of the long-distance telephone was made in Chicago last week, when Theodore Thomas presented himself at the long distance office and listened with critical attention to the piano-playing of a young lady in New York. The young lady is Miss Minnie Wetzler, formerly of Chicago, who is desirous of playing in concert with Mr. Thomas during the World's Fair. Before making any contract it was necessary for Mr. Thomas to hear her play. Miss Wetzler hadn't the time to come to Chicago and Mr. Thomas hadn't the time to go to New York. It was therefore decided that a test recital should be given by telephone. The music was transmitted perfectly, and Mr. Thomas told the young lady that he would send her his decision by letter.

TELEGRAPH.

A. P. Morgan of Little Rock, Ark., has brought suit for $1,000 damages against the Western Union Telegraph company for the failure to deliver a message addressed to him from Spartanburg, S. C., February 25 1892. The messsage announced the death of Morgan's mother, and Morgan claims that it was not delivered until he called at the office for it on the evening of February 26th.

About 2:30 P. M., on Tuesday of last week fire was discovered in a small room in the center of the second floor of the Western Union building, in Chicago, in which waste paper had been stored. The flames flared up and were seen to burn brightly through a window in one side of the room, but the door was locked. An alarm was sent in and when the department arrived the fire was extinguished with little loss. The news of the fire had reached the operators' room on the top floor and an exciting scene ensued. Manager W. R. Bollinger notified his employes to leave their positions quietly and get out of the building. They started for the stairways and fire-escapes to the roofs of adjacent buildings, but it was impossible to preserve order. The female operators became frantic and rushed for the outlets from the room. They crowded upon each other and pushed Miss Alice Walsh headlong down the stairs to the third floor. Several fainted and were unable to reach the head of the stairs. A messenger had been dispatched to the second floor, and he returned about in time to meet the fleeing operators at the head of the third stairway and notify them that the danger was over. Quiet was finally restored, and the girls who had fainted were taken to the dressing-room and revived, after which they were taken home in carriages.

MISCELLANEOUS.

Kansas City, Kan., is contemplating putting in a fire alarm system in the near future.

The Legislature of Michigan is considering a bill providing for the substitution of electrical execution for hanging in capital cases in that state.

On February 10th H. T. Paiste, of Philadelphia, brought suit against the Hart & Hegeman Manufacturing company of Hartford, Conn., in the United States Circuit Court in that city, for damages and an injunction to prevent it from manufacturing and selling certain eccentric movement switches which the plaintiff claims to be infringements on his patent of October 4, 1892, No. 483,862.

The Western Electric company brought an injunction suit against the Brush Electric company of Cleveland in the United States Circuit Court at Chicago, March 8th, to restrain the latter from manufacturing and using certain instruments for electrical testing which were invented by C. H. Rudd. The complainant also asks for an accounting. The Western Electric company claims that it acquired in June last the exclusive right to manufacture and use the apparatus patented by Mr. Rudd.

TRADE NEWS.

The constantly increasing demand for Buckeye incandescent lamps may lead, it is rumored, to an increased output of 10,000 lamps per day in the Buckeye Electric company's factory.

The W. S. Edwards Manufacturing company of Chicago has removed from 86 and 88 West Lake street to 21 and 23 East Lake street, where it has secured improved facilities for handling his growing business.

Among the catalogues recently issued, that describing the Dick and Church engine, built by the Phœnix Iron Works company, Meadville, Pa., is conspicuous on account of the clear and concise manner in which the construction and operation of these engines are explained The catalogue is profusely illustrated and there are many valuable draw

ings that will be appreciated by engine men generally. The company makes a special feature of engines and steam plants for electric light and power stations.

The Hill Clutch Works of Cleveland, O., has issued a very convenient "daily reminder," a sort of calendar, diary and memorandum book combined, in vest-pocket shape and tastefully bound. The Chicago office of the company is at 347 Rookery.

The Ansonia Electric company, formerly the Electrical Supply company, Chicago, has in preparation a book of tables and other information of use in electrical work, which will be found unusually valuable. Some original tables of great value have been obtained for this work.

The pocket catalogue issued by the Consolidated Electric Manufacturing company, of Boston, presents in an attractive way the features of many of the specialties that this company is handling. The catalogue is fully illustrated and contains concise descriptions of the specialties mentioned.

Gustave Monrath, of Chicago, has taken an office in the Monadnock building, and will hereafter engage in business as an independent electrical engineer and contractor. Mr. Monrath during the last year has made extensive experiments with high potential currents for lighting and power service and will make this line of work a specialty.

J. C. Mortimer & Co. is the name of a new concern which has made itself known to the trade through a neat circular. This firm will deal in new and second-hand electrical apparatus of any description. It will also do work in re-winding armatures and repairs of all kinds. The firm's headquarters are at 136 Liberty street, New York.

The Joseph Dixon Crucible company has been awarded space in the Columbian Exposition—a space 25 by 28 feet in the mines building for a general exhibit of graphite productions including specialties for electrical and other work. A space of 13 by 10 feet only was obtainable in the manufactures building for an exhibit of Dixon's "American graphite" pencils and pencil sundries.

An attractive pamphlet illustrating and describing a number of devices known to the trade as "Cutter's specialties" has just been is ued by George Cutter, Chicago. It is a creditable production, and will no doubt attract much attention, for, while it does not attempt to cover the whole field of electrical supplies, the selection and arrangement of the articles illustrated is admirable.

The Great Western Manufacturing company of Chicago has been awarded the contract for the equipment of the Fond du Lac Street Railway, Light & Power company, of Fond du Lac, Wis. The lighting plant will include 100 2,000 candle power arc lights and 4,000 incandescent lights. The street railway equipment consists of 10 miles of line and 20 motors.

Just at this season of the year, when it is not quite cold enough to keep up furnace or stove fires, the electric radiators and heating apparatus come in as a very happy and convenient substitute to those having electric current available. The Ansonia Electric company is in receipt of a letter from one of its customers containing the following: "My wife objected very strongly to using one of your sad-irons when I first purchased one, but now she will use it in preference to the old style and would not be without one. I am using one of your disk heaters and am more than pleased with it. The city marshal and myself eat lunch together, and on this one disk heater we cook beefsteak or eggs boil coffee, potatoes, fry ham or anything we want for our mid-light lunch. After persons have once used these articles they cannot do without them any more than they can the electric light."

BUSINESS.

The Great Western Manufacturing company of Chicago is making arrangements to install machinery and furnaces for drawing wire in its Duluth works. The capacity designed at present is 20,000 pounds per day. It is expected that this will be in working order by the first of September.

The Ball Engine company of Erie, Pa., has made several large shipments recently to electric light and street railway companies. Within the last few weeks this company has shipped 34 engines, ranging from 25 to 300 horse power, and several steam plants. Its factories at present are working at their full capacity.

The Oconomowoc, Wis., Electric Lighting company has let contracts for machinery. John More & Son, of Chicago, will furnish the boilers; the E. P. Allis company, of Milwaukee, will build the engines, and the electrical machinery will be supplied by the General Electric company. The engines will be two Reynolds-Corliss machines of 150 horse power each.

At Ashland, Wis., articles of incorporation of a new electric power and storage battery company have been filed. The capital stock is $100,000. The company will manufacture accumulators under a patent secured by Leslie B. Howley, of Ashland. That gentleman is now purchasing the necessary machinery and it is expected that the company will begin operations at once.

The Central Electric company, Chicago, advises the trade that it is monthly distributing the *Architect Bulletin* published by the Interior Conduit & Insulation company. This pamphlet gives a brief description of the principal buildings in the country in which the complete system of conduiting and Okonite wire has been placed during the previous month. The Central Electric company will mail one of these copies to any one sending an address, and will forward a copy of the bulletin each month free of charge. This book will no doubt prove of interest and profit to contractors and central station men, as the Interior Conduit company is constantly putting new and improved devices upon the market. The Central Electric company has also just placed upon the market a hard rubber hydrometer, which is pronounced to be vastly superior to the old form of glass hydrometer.

E. F. Seias, representing the Chicago & St. Louis Electric Railroad company, has just returned from an extended trip through Missouri and Kansas, and reports that great interest is manifested in the proposed road. The westerners are looking forward with delight to the accomplishment of this undertaking, which they look upon as indicating the possibility of connecting a great many of their cities by electric railways.

Curtis & Curtis, Bridgeport, Conn., announce that they have been granted an injunction against the Wells Machine company, restraining the latter from manufacturing the machines which have been declared infringements of the former's patents. Attention is further called to the fact that Willet C. Wells has transferred his business to the Merrill Manufacturing company, which is continuing the manufacture of pipe threading machines.

The James P. Warren Tin, Copper and Sheet Iron Works, 51-53 N Jefferson street, Chicago, are quite successful in the introduction of their Acme exhaust pipe head. This head is to be used in connection with the Crane company's exhibit at the World's Fair. There will be in all seven of the Acme heads employed in steam plants on the exhibition grounds. The Acme pipe head stops all water and grease emitted from exhaust pipes and prevents roofs and walls being rotted by exhaust steam.

To judge from present indications the new Mosher alternating arc lamp for constant potential circuits will prove to be a bonanza for its manufacturer. During a recent conversation with G. L Reimann, president of the company, a representative of the WESTERN ELECTRICIAN was shown a letter from a supply house ordering 200 Mosher lamps per month for one year. One-half this lot of lamps is to be of the new alternating constant potential type, and the other half is to be for ordinary direct current circuits. Such an order as this speaks well for this enterprising concern.

The Mica Insulator company filed articles of incorporation March 1st at Elizabeth, N. J., the authorized capital stock being placed at $100,000, all paid in. The company's plant is located at Schenectady, N. Y., while its office and salesroom will be at 218 Water street, New York. The officers are: Eugene Munsell, president; Franklin Brooks, vice president, and Lewis W. Kingsley, secretary and treasurer. The company will manufacture micanite for electrical insulation. Through a process controlled by this interest, small scrap mica is now utilized in all forms and shapes for insulating purposes where sheet mica was formerly used, at a much reduced cost, and with no diminution in efficiency.

Some changes have been made in the management of the National Electric Manufacturing company of Eau Claire, Wis. At a recent meeting of the directors of the company, Fitch Gilbert was re-elected to the presidency of the company; Morgan Brooks, the largest individual stockholder, was made vice-president, and W. M. Lenhart, who has been assistant general manager, was promoted to the position of general manager, to succeed C A. Daigh, who was vice president. Mr. Daigh has assumed the management of the Chicago office. Paul W. Bossart, who has been in charge of the Chicago office, has resigned to accept a position with the newly organized Adams Electric company. Under the new arrangement Mr. Daigh takes charge of a large territory for the National company. F. A. Young, who has been connected with the Chicago & Great Western Railway company, will be Mr. Daigh's assistant at the Chicago office.

To those contemplating the purchase of insulated wires or cables it will be of some interest to read the following extract from a letter received by the Ansonia Electric company (formerly the Electrical Supply company), Chicago: "We average from 330 to 4 000 volts on our circuits, and during the entire period of our use of Habirshaw insulation we have never had a single burn-out or ground on any of our underground circuits, many of which are constantly immersed in water; in fact our underground service has given greater satisfaction than we had expected, and we have every reason to attribute it to the superior quality of the Habirshaw cables which we use. As an evidence of our experience with your cables we have placed an order for immediate shipment for five miles more of the Habirshaw cables for underground work, some of which will displace other cables." This letter was written several months ago and as still another evidence of satisfaction, the same company has again ordered over five miles of special Habirshaw insulation.

ELECTRICAL PATENTS.

Issued March 7, 1893

492,773. Electro Magnetic Brake. Andrus D. Ayres, Kalamazoo, Mich.

A series of electro-magnets is carried upon a spider secured to the truck of the car, if the brake is to be applied to a car. The electro-magnets are arranged in a circle, and are adapted to move within a series of cylinders of magnetic material, also arranged in a circle but attached to the car wheels or the car axle. When it is desired to apply the brake current is sent through the electro-magnets, which induce poles in the surrounding cylinders, and the magnetism thus produced tends to stop the motion of the electro-magnets.

492,776. Automatic Electric Switch. Andrew M. Coyle, Baltimore, Md.

492,784. Speaking Telegraph. Thomas A. Edison, Menlo Park, N. J.

Attached to the diaphragm of the telephone is an electrode which is immersed in a vessel of conducting liquid. Opposite this electrode, but not in contact, is a second electrode attached to one side of an electric circuit. The electrode attached to the diaphragm is connected with the other side of the circuit, the circuit being completed through the liquid, and the vibration of the diaphragm caused by the voice causes a greater or less amount of the liquid to be included in the circuit to vary the resistance.

492,807. Automatic Circuit Breaker. Delos Irish and John G. Williams, Salt Lake City, Utah.

492,808. Adjustable Lamp Hanger. Nicholas Jenkins, Waterbury, Conn.

492,809. Incandescent Lamp. John Von Der Kammer, Chicago, Ill.

492,811. Wire Connector. William S. Kisinger, Bellevue, Ky.

The connector comprises a cylindrical sleeve having conical ends provided with holes at the apex through which the wires to be coupled pass. Between the wire and the sloping side of the end of the sleeve is interposed a wedge provided with teeth to engage with the wire. Any tension upon the wire causes a firmer gripping of the wire.

492,815. Electric Arc Lamp. Carl K. MacFadden, Chicago, Ill.

The upper carbon is uniformly and continuously fed by mechanical means, while to the lower carbon is attached the core of a solenoid which surrounds the lower end of the carbon. To the lower end of the core is secured the piston of a dash-pot.

492,837. Apparatus for Automatically Stopping Railway Trains. Edward W. Robinson, Boston, Mass.

492,847. Balanced Electric Drop Light Hanger. Truman E. Stevens, Blair, Neb.

492,850. Combined Indicating Electric Switch and Current Reverser. Almon B. Strowger and Walter S. Strowger, Chicago, Ill.

492,866. Automatic Electric Sprinkler and Alarm. Charles S. Hurd, Cleveland, O.

492,881. Leading Piece for Overhead Electric Railways. Henry D. Winton, Wellesley, Mass.

492,882. Street Car. John O. Adsit, Hornellsville, N. Y., and Charles H. Wickham, Tioga, Pa.

492,883. Telephone Transmitter. Charles T. Bloomer, New York, N. Y.

Between a pair of conducting plates is interposed finely divided carbon, the plates being also connected by means of one or more spiral strips or ribbons embedded in the carbon. One of the plates is carried upon or secured to the diaphragm, the other being stationary, so that as the diaphragm vibrates the pressure upon the mass of carbon will be varied, which, with the change in the position of the coils of the spirals, alters the resistance between the plates. With this arrangement the resistance can never increase above a definite amount, due to the presence of the spiral strips.

492,888. Dynamo-electric Machine and Motor. Rudolph M. Hunter, Philadelphia, Pa.

The machine is of the multipolar type, and is provided with a Gramme ring armature wound with several windings so connected that the current generated in one winding will pass through the other windings in series, thus producing the effect of several separate machines connected in series.

492,913. Electric Lamp Lighter. Josephus C. Chambers, Detroit, Mich.

492,932. Safety Guard for Cars. Norman C. Bassett, Lynn, Mass.

492,961. Game Apparatus. Sidney N. Johnson, Chicago, Ill.

492,971. Electric Programme Clock. Andrew J. Reams, Wichita, Kan.

492,999 Luminous Fountain. Gustave Trouve, Paris, France.

493,000. Electric Steering Gear. Lewis S. Van Duzer, U. S Navy.

493,007. Secondary Battery Electrode. Isaac H. Bartholomew, Northford, Conn.

493,009. Automatic Switch. Charles H. Bedell, Swarthmore, Pa.

493,023. Process of Obtaining Chlorates of the Alkalies or of the Alkaline Earth Metals by Electrolysis. William T. Gibbs and Stanislaus P. Franchot, Buckingham, Canada.

493,025. Armature for Electric Motors. Robert H. Hassler, Dayton, O.

493,030. Combined Cigar Cutter and Electric Lighter. Abel Huot, New York, N. Y.

493,067. Hotel Time Annunciator. Franklin S. Carter, Burlington, N. J.

493,089. Truck for Electric Locomotives. John C. Henry New York, N. Y.

The motor is supported upon a frame connected rigidly to one of the truck axles, and having a spring connection with the other axle. The king-pin is carried upon the field magnets of the motor so that the whole weight of the car is transmitted to the motor field magnets and from thence to the frame and axles of the truck.

493,104. Dynamo-electric Machine. William M. Mordey, London, Eng.

493,109. Incandescent Lamp Socket. James F. McLaughlin, Philadelphia, Pa.

493,125. Electric Railroad Danger Signal and Bell. Paul Seiler, San Francisco, Cal.

493,212. Trolley Wire Support. Frank E. Head, Toledo, O.

493,221. Apparatus for Transferring Secondary Batteries. Mathias Pfatischer, Philadelphia, Pa.

EUGENE F. PHILLIPS, Prest. W. A. HATHAWAY, Treas. W. H. SAWYER, Sec'y.

AMERICAN ELECTRICAL WORKS,

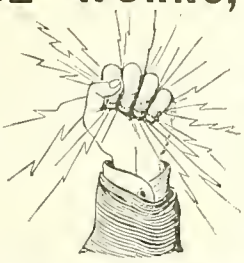
PROVIDENCE, R. I.

RAILWAY FEEDER AND TROLLEY WIRE,

ELECTRIC LIGHT LINE WIRE,

Incandescent and Flexible Cords,

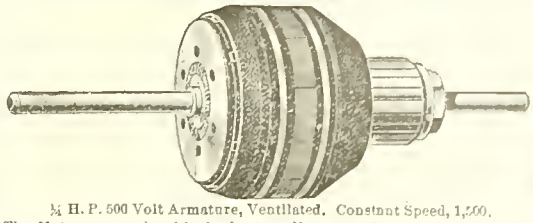
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



NEW YORK OFFICE, P. C. Ackerman, 10 Cortlandt Street.

MONTREAL BRANCH, Eugene F. Phillips' Electrical Works

CROCKER-WHEELER ELECTRIC COMPANY,



SLOW SPEED MOTORS.

¼ H. P. 500 Volt Armature, Ventilated. Constant Speed, 1,500.

The Motors are made with the best appliances and material obtainable, and embody every improvement of merit, with the intention that they shall be the Standard of their class.

430 West 14th Street. - - - - - NEW YORK.

THE "CLARK" WIRE.

TRADE MARK.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, he says: "A thoroughly reliable and desirable Wire in every respect"

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

EASTERN ELECTRIC CABLE CO.,

61 to 65 Hampshire Street, BOSTON, MASS.

HENRY A. CLARK, Treasurer and Gen'l Manager.

HERBERT H. EUSTIS, President and Electrician.

A LONG FELT WANT SUPPLIED.

WRITE FOR PRICES AND SAMPLES OF

"Crescent" Overhead Line Wire. It will Surprise You.

THE CRESCENT INSULATED WIRE & CABLE CO.,

MANUFACTURERS OF ALL KINDS OF

SEAMLESS RUBBER WIRES AND CABLES,

FACTORY AND MAIN OFFICE, TRENTON, N. J.

JOHN A. ROEBLING'S SONS CO., General Western Agents, 171 and 173 Lake St. Chicago, Ill.

ANY CANDLE POWER. THE ANY VOLTAGE.

"STEUBEN" LAMP.

STEUBEN LAMP WORKS, CANISTEO, N. Y.

Write for Prices. Samples Free.

PLATINUM

For all kinds of Electrical Use. Sheet or Wire of any Degree of Hardness.

Special Attention given to Platinum for Incandescent Lamps.

Address WE CARRY THE LARGEST STOCK IN AMERICA.

G. SIEBERT, HANAU, GERMANY.

The Osborne Steam Engineering Co.,

ENGINEERS,

Rooms 714-715, 167 Dearborn St., - Chicago

Representative work now in course of construction, 2 000 H. P. Heat, Light and Power Plant for the Pabst Heat, Light & Power Co., Milwaukee, Wis

Those who contemplate the construction of similar plants on improved and economical lines will do well to communicate with us. First, be sure you will get the best, then go ahead.

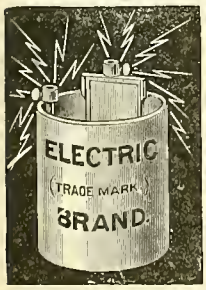
PURE

SAL-AMMONIAC.

Guaranteed Over 99 Per Cent. Pure.

INNIS & CO.,

161 Kinzie St. Chicago.



SAL AMMONIAC

(ELECTRIC BRAND)

For Electrical Purposes

Guaranteed 98/99% and free of lead and iron. If you want the best quality ask your dealer for this brand. Imported by

A. KLIPSTEIN, 122 Pearl St., New York.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

SAMSON BRAIDED CORD.

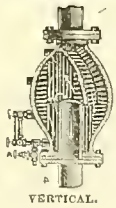
Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

Send for Samples and Prices.

SAMSON CORDAGE WORKS,

115 CONGRESS STREET, BOSTON.

HINE'S ELIMINATOR.



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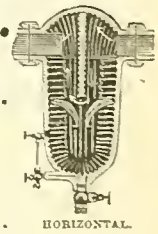
THE ACKNOWLEDGED SUPERIOR OF ALL

Steam Separators and Oil Extractors.

In twelve trials in the "Cornell" Separator test, it averaged 98 7-10 per cent Dry Steam. Outstripping all competitors.

Send for Circular and Cornell test report.

HINE ELIMINATOR CO., 106 Liberty St., NEW YORK.



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IS COMPLETE WITHOUT OUR

Portable Standard Testing Resistance Set.

It can be used under every condition of practical work, and is the only instrument of its class unaffected by magnetic fields or mechanical jars.

Ask for Descriptive Circular No. 285.

Manufactured by

QUEEN & CO., Incorporated, Philadelphia.

Illustrated Catalogue 1-66 mailed upon receipt of 5 cents.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

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—BRANCH STORE—

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NOTICE.

Party representing ample capital for the purpose, wishes to correspond with Inventor or Owner of a really good Motor Type Incandescent Meter, with a view to manufacturing the same. State full particulars, and if article is patented give number of patent. Address

Motor Meter,
Care WESTERN ELECTRICIAN, Chicago, Ill.

WANTED.

An experienced man to take charge of experimental department of large electrical works. Must be a first-class mechanic, thoroughly conversant with Telephone, Telegraph, Medical Battery and General Electric Work, and competent to develop articles and put them on a commercial manufacturing basis. Address, "Foreman,"
care WESTERN ELECTRICIAN.

TRADERS IN ELECTRICAL MACHINERY.

FOR SALE (Continued List).

Two 30 light Ball arc dynamos, with 60 arc lamps.
One 25 light Ball arc dynamo, with 25 arc lamps.
One 80 light Mather incandescent dynamo, 110 volt.
One 8 horse power Card motor, 500 volt.

NOWOTNY ELECTRIC CO.,
30 E. 5th St., CINCINNATI, OHIO.

FOR SALE.

At a sacrifice—A twenty-three arc light dynamo, with ammeter and sliding base—and twenty 2,000 C. P. new arc lamps complete and guaranteed. Address

J. C. Mortimer & Co.,
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Shepard's Celebrated 860

Screw Cutting Foot Lathe,

Foot and Power Lathes
From 9 to 26 Inches.
Also Drill Presses, Hand and Power Planers, and Supplies. Just the Tools for Electricians. Send for Illustrated Catalogue to

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ENGINE CASTINGS

from one-eighth to six horse power Horizontal and Marine.

8, 16 and 60 LIGHT DYNAMO CASTINGS

Simple sewing Machine and Fan Motor Castings with Instructions for building complete machines. Send stamp for Catalogue.

Palmer Bros., Electrical Supplies, Mianus, Conn.

FOR SALE.

Two [illegible] H. P. U. S. Dynamos.
Two [illegible] H. P. U. S. Dynamos.
Two Straight T.-H. Dynamos, compound wound, with Base, Rheostat and Ammeter.
Two [illegible] Arc Dynamos.
One [illegible] Arc Dynamo.
Ten 125 light Keeley Dynamos with lamps.
Two [illegible] Incandescent Machines, 25 volts.
One [illegible] Arm Engine and Shafting.
Two [illegible] Boiler, Dynamos, and fixtures.

We Buy Outright Electrical Equipment.

JOHN E. BREGA MFG. & SUPPLY CO.,
71 CORTLANDT ST., N. Y.

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ENGINES Over 3000 in Service. Simple or Compound. Send for Cir

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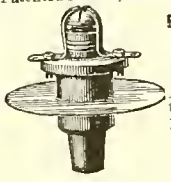
For all Purposes.

Scrap and Native Platinum Purchased.
BAKER & CO., 408-414 New Jersey Railroad Ave., Newark, N. J.

Patented Jan. 22, 1884.



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Electric Lava Gas Tip
Multiple Lighting
For Churches, Theaters and Public Halls.
Are used all over the country. Send for estimates or prices to

A. T. SMITH,
6 W. 14th St., New York.

ARMATURES REWOUND.

Street Railway and Electric Lighting Companies will find it to their interest to write for prices, as we do all kinds of electrical repair work.

McLEAN & SCHMITT,
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Manufacturers of
OCTAGONAL AND CEDAR
TELEPHONE & ELECTRICAL
RAILWAY POLES & CROSS ARMS
THE H. M. LOUD & SONS LUMBER CO.
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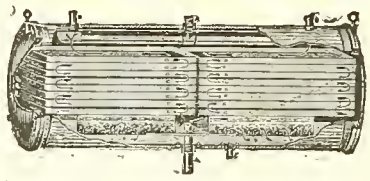
Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

WILLIAM A. ROSENBAUM,
Electrical Expert and Patent Solicitor,
Times Building, NEW YORK.

Former Manager, now Successor to the PATENT DEPARTMENT OF THE W. J. JOHNSTON CO., LTD. ("The Electrical World.")

Bids for Electric Lighting.

The city of Shreveport will receive sealed bids up to Wednesday, April 13, 1893, for lighting the city for one or three years, beginning from June 9, 1893, with forty-one arc electric lights. Certified check for twenty-five hundred dollars ($2,500.00) as a guarantee of good faith to accompany the bid. Price per light, system to be used, and candle power specified. Right reserved to reject any and all bids. For further information address

N. B. MURFF,
Controller, City Hall, Shreveport, La.

GONDA BATTERIES.

TRADE MARK.

THE STANDARD OPEN CIRCUIT BATTERIES OF THE WORLD,
And the best made anywhere.
SEND FOR CIRCULAR & PRICES.

The Leclanché Battery Co.
111 to 117 East 131st St., N. Y.

Receiver's Sale of Street Railway

At Milwaukee, Wisconsin.

Notice is hereby given that in pursuance of an order of the Circuit Court of Milwaukee County, Wisconsin, I will, on the 30th day of June A. D. 1893, at eleven o'clock in the forenoon of said day, at the south door of the Court House in the city and county of Milwaukee, Wisconsin, offer for sale and sell at public auction as an entirety, the street railway of the Milwaukee Electric Railway Company in said city of Milwaukee, with all the franchises and rights and privileges of said railway company for the operation and maintenance of the same, and all the property of said corporation used in or in connection with, or essential to the exercise of its said franchises.

Said railway property and franchises consist of about 6½ miles of double track, being about 13 miles of single track, in said city of Milwaukee, with all the poles, wires, cables, trucks, ties, stringers, fixtures and appliances composing or used in connection with said tracks or said railway, with franchises, privileges and rights derived from ordinances of the common council of the city of Milwaukee to maintain and operate said road; also sundry parcels of real estate in said city, with car barns and power house thereon; also the engines, boilers, machinery and rolling stock and supplies of said road.

The terms of such sale are cash.

The said street railway will be sold free of all liens and encumbrances except judgments of foreclosure and sales aggregating $21,193.56, with interest from the 22d day of November, 1892, at 7 per cent. on $1,259.60 thereof, and at 6 per cent. per annum on the remainder. Said judgments of foreclosure covering the said specific parcels of real estate.

Dated Milwaukee, Wis., Feb. 27, 1893.

G. J. MELMS,
Receiver of the Milwaukee Electric Railway Company.

Link-Belt Machinery Co.,

CHICAGO,

Coal and Ash Handling Machinery.
Manila Rope Transmissions.
Friction Clutches.
General Machinery.
Gear, Pulley, Sheave and Fly Wheel Castings.

Link-Belt Engineering Co.,
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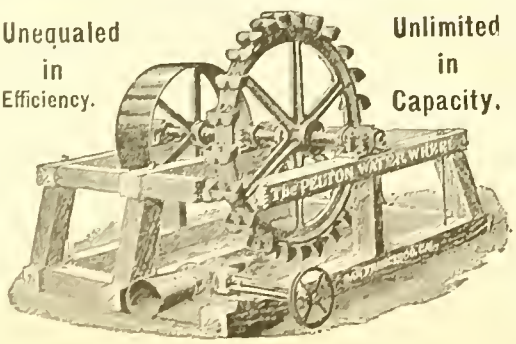
THE PELTON WATER WHEEL

Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

Unequaled in Efficiency.



Unlimited in Capacity.

Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 20 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

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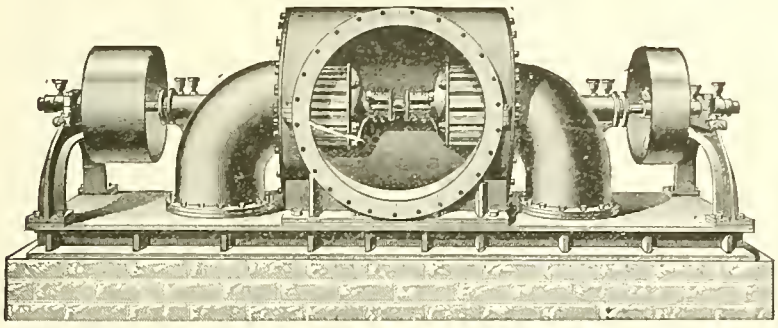

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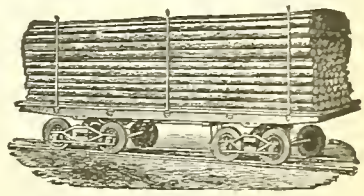

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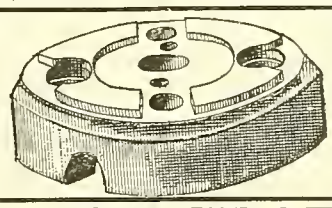

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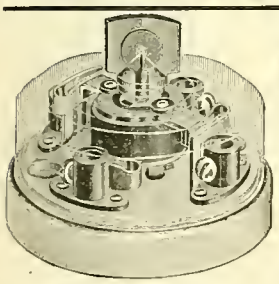

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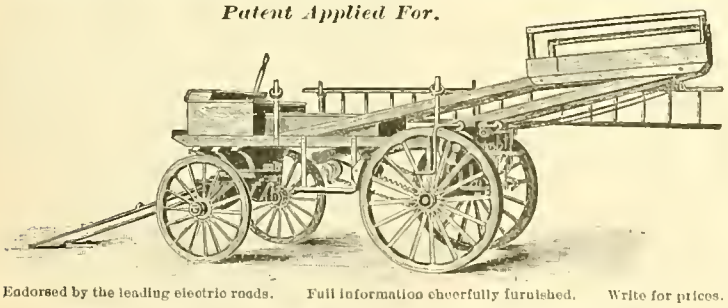

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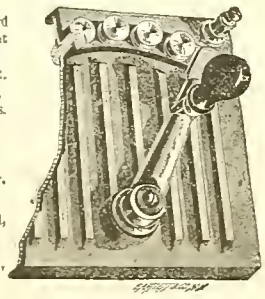

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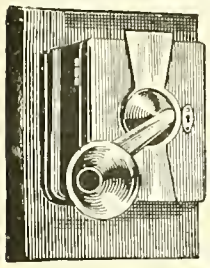

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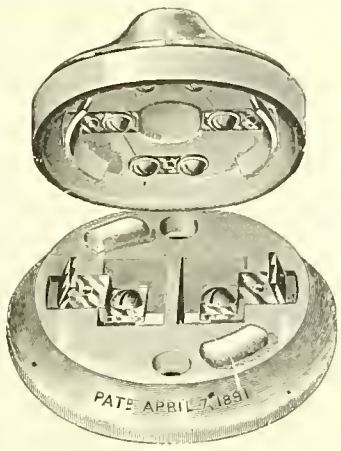

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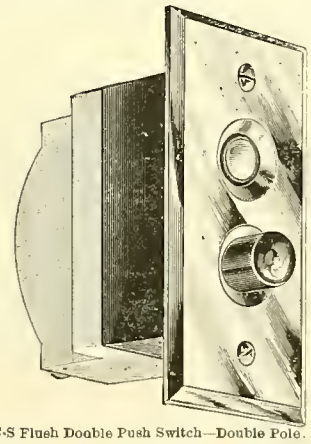

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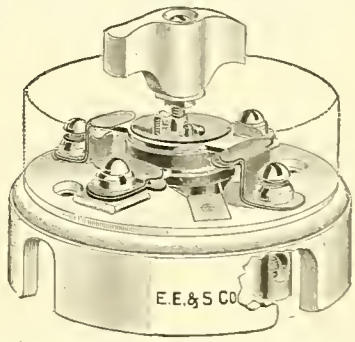

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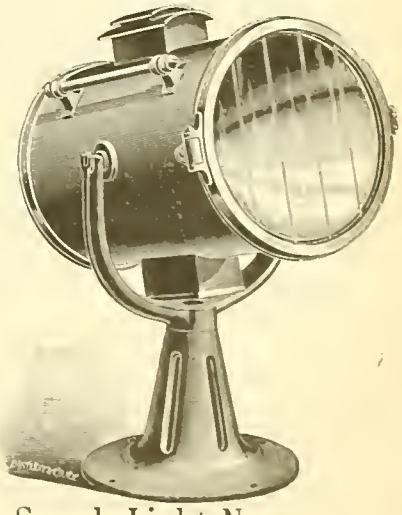

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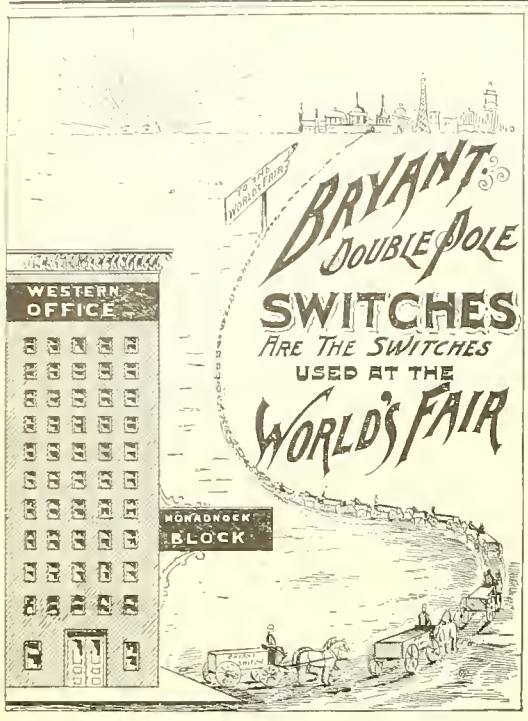

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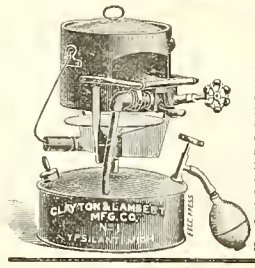

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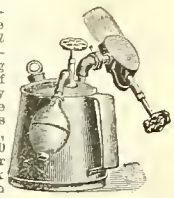

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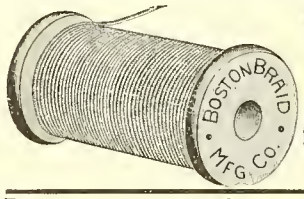

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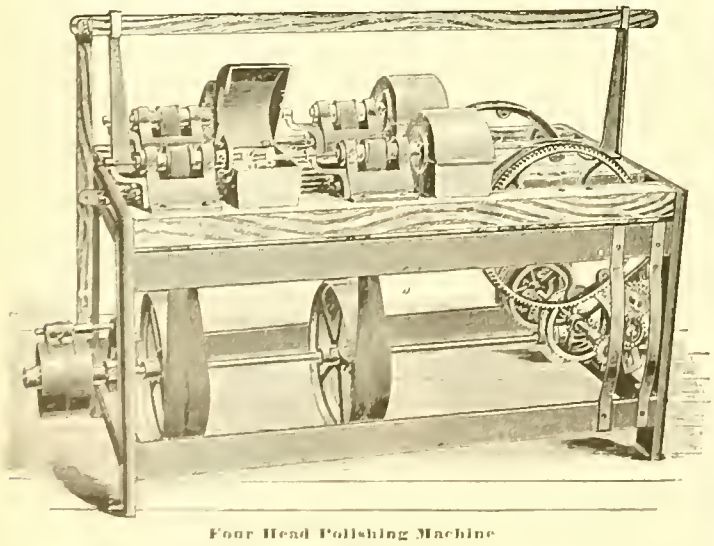

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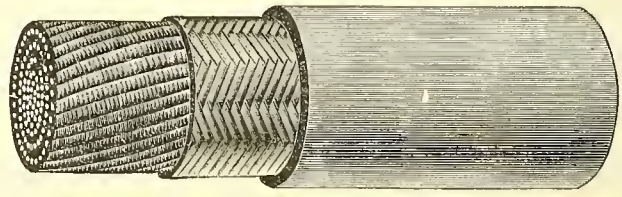

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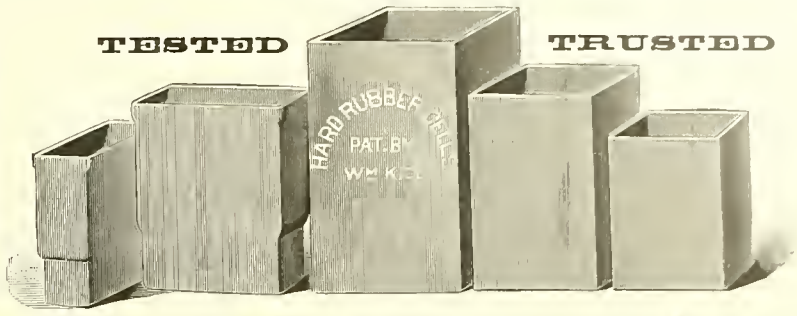

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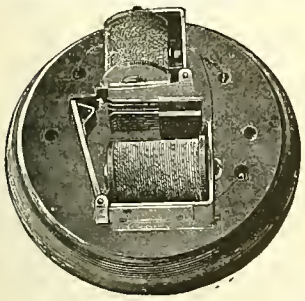

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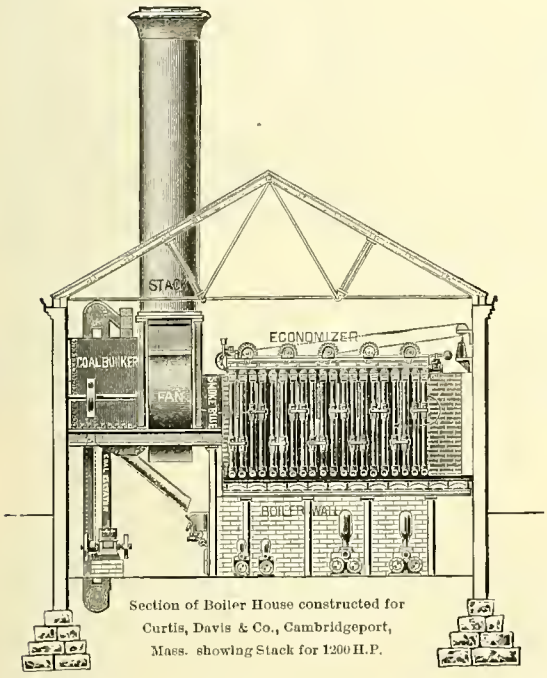

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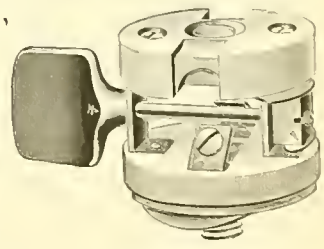

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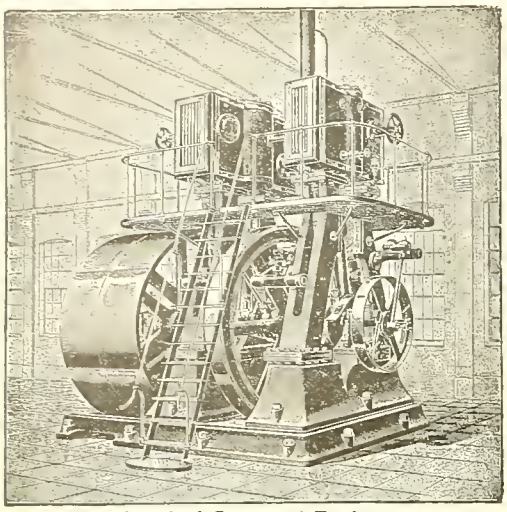

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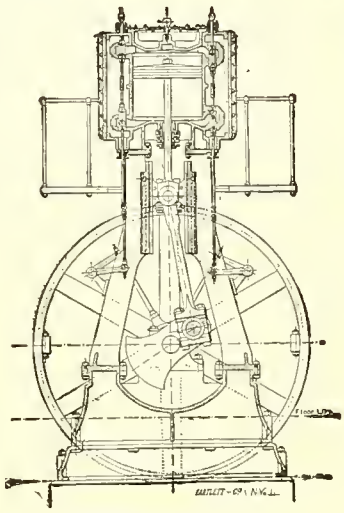

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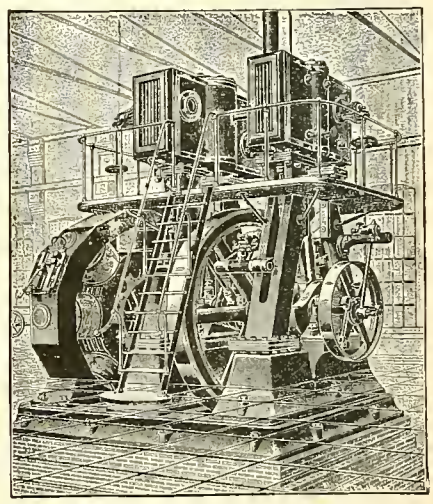

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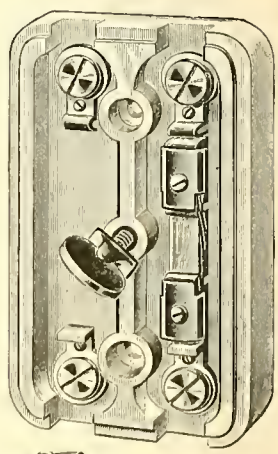

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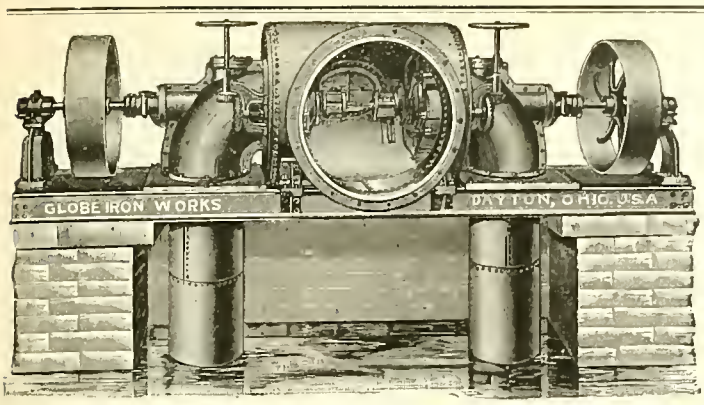

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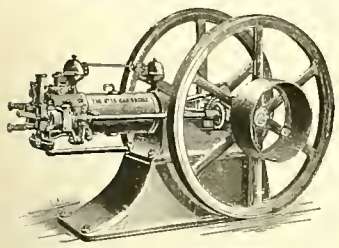

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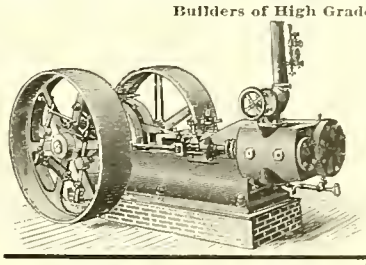

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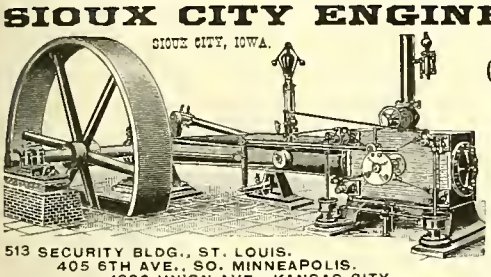

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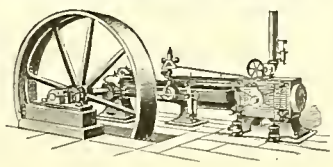

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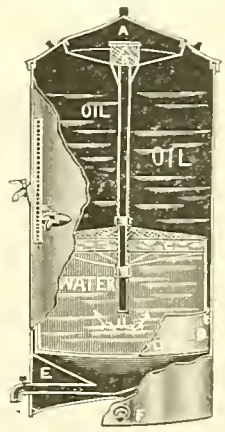

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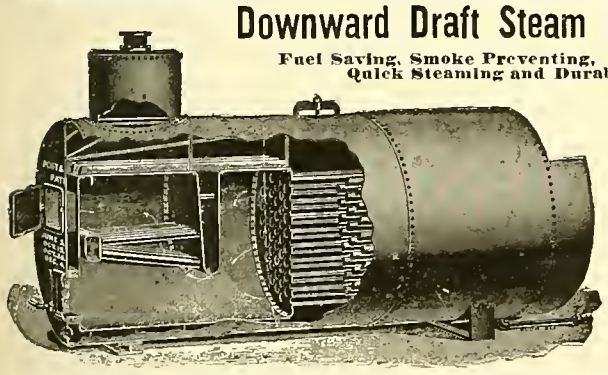

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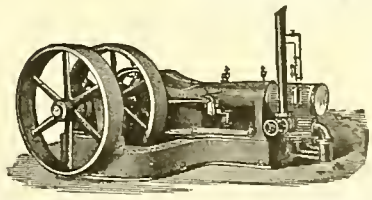

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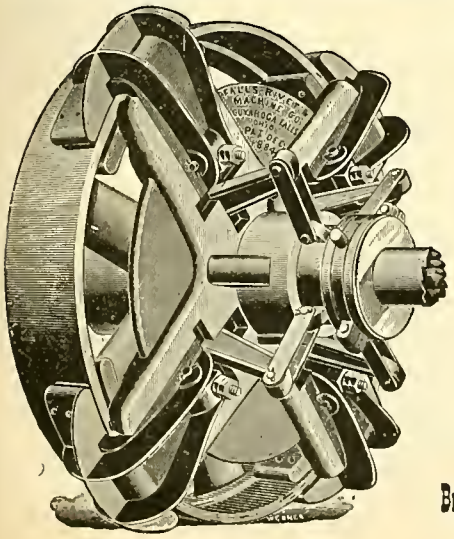

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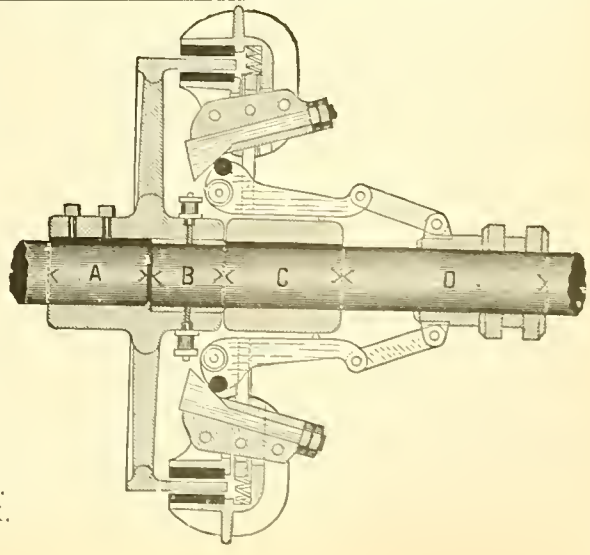

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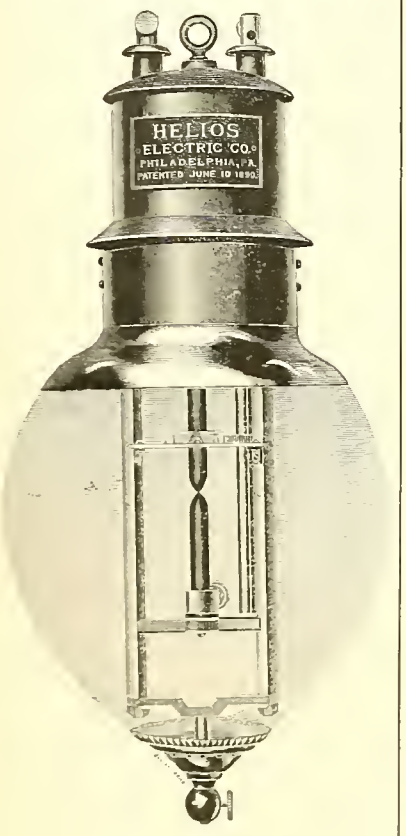

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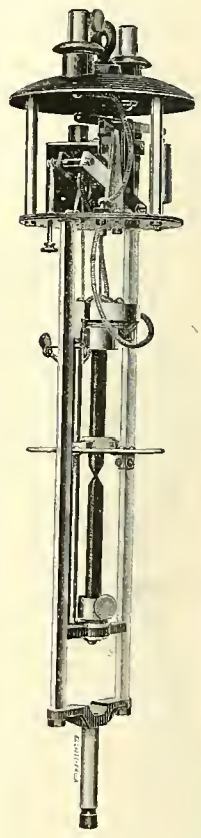

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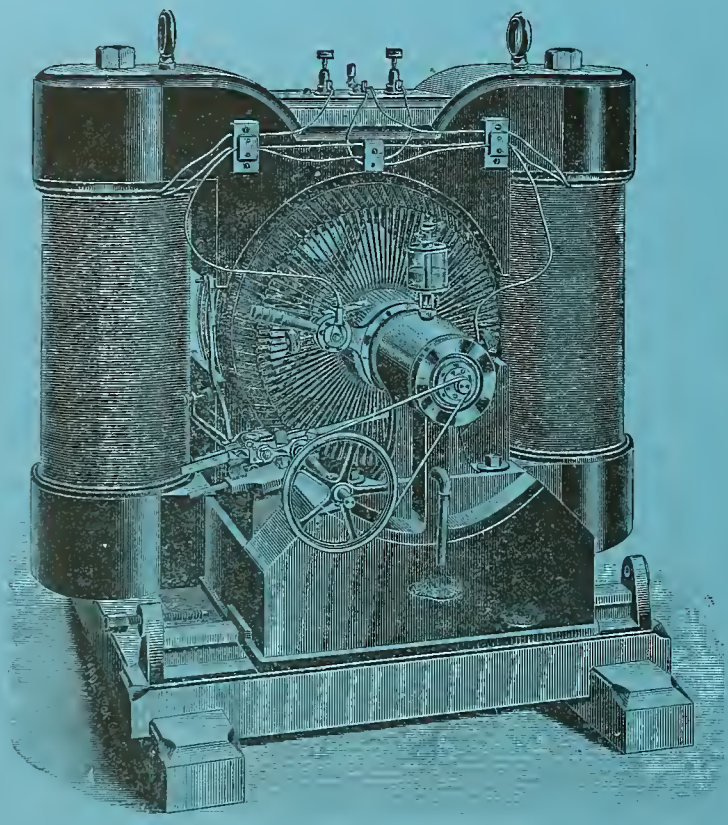

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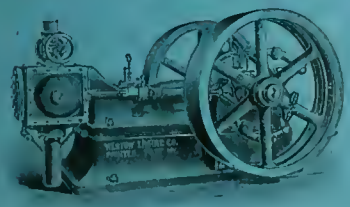

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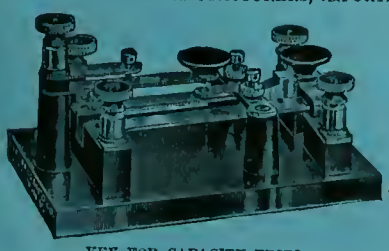

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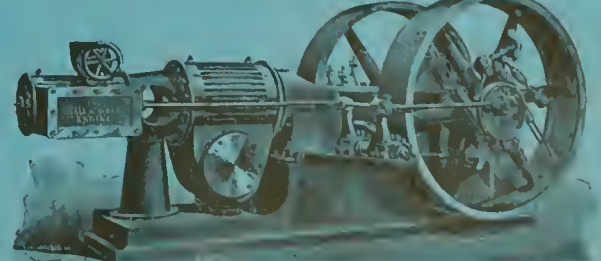

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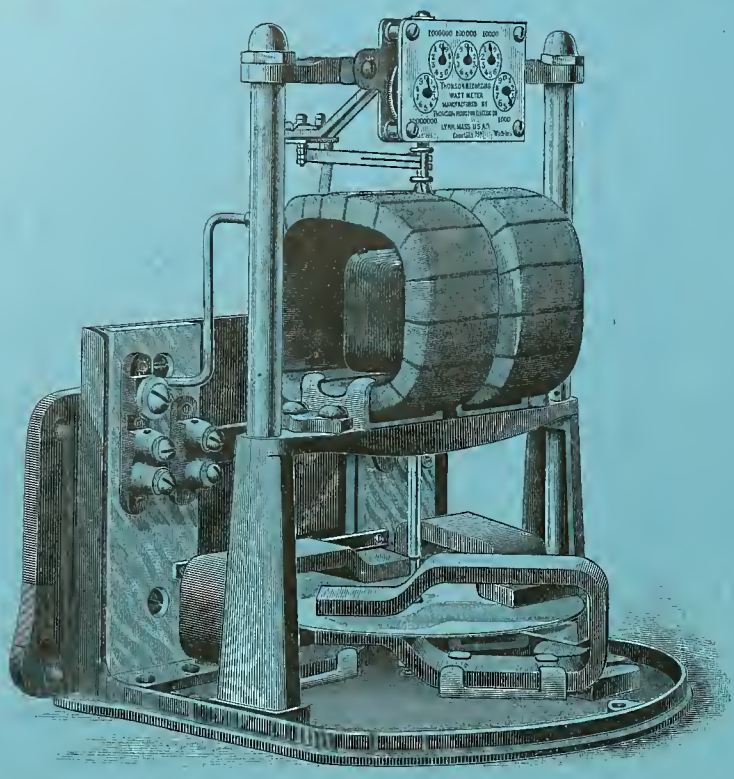

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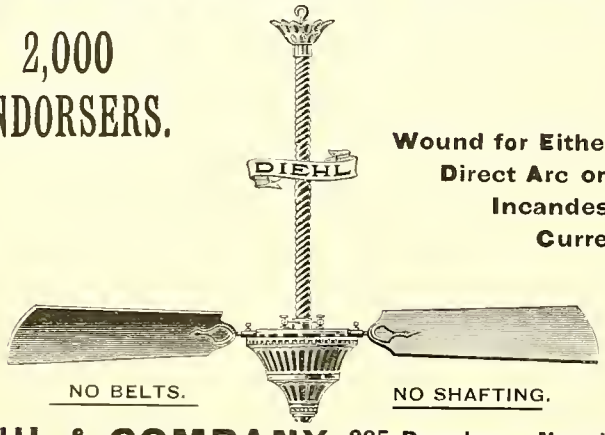

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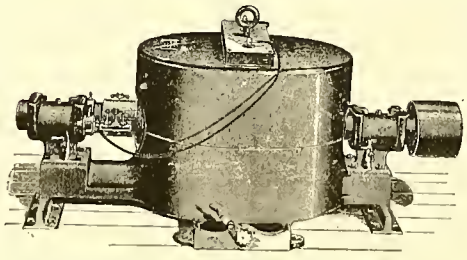

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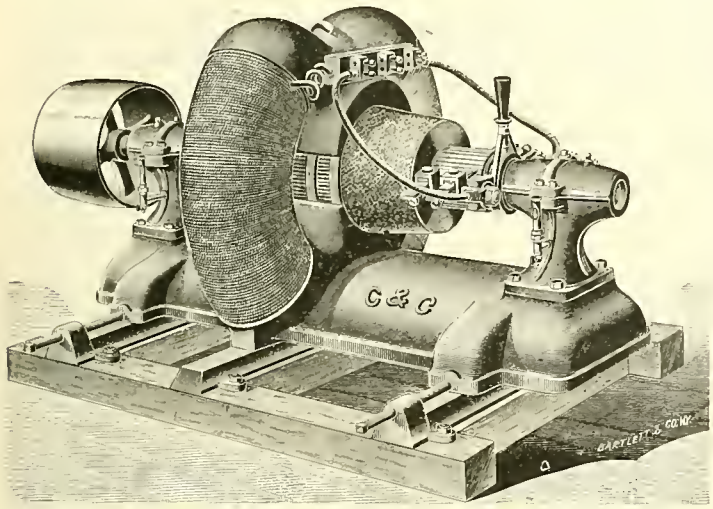

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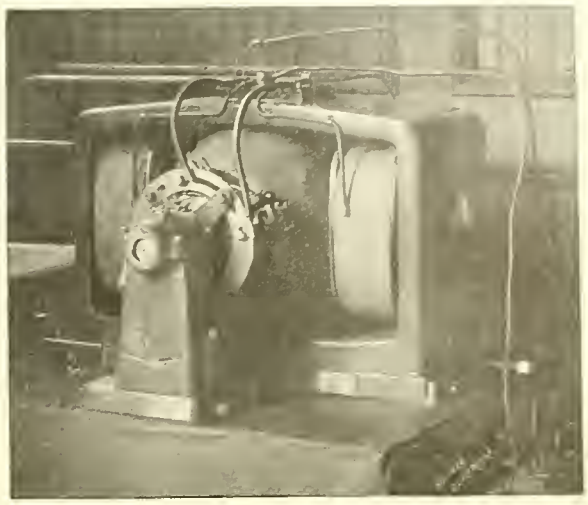

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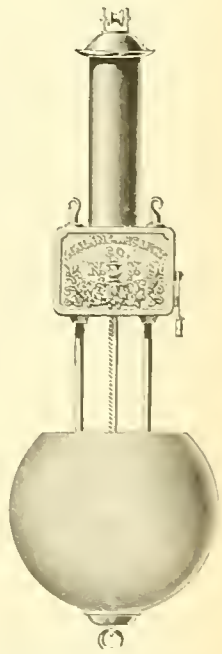

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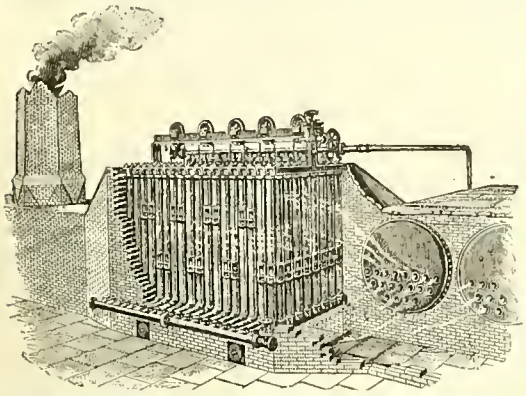

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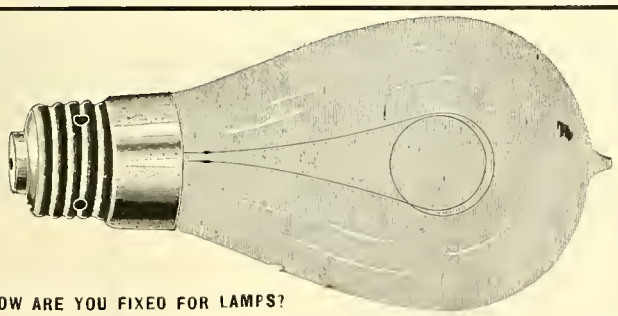

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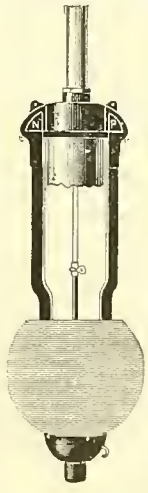

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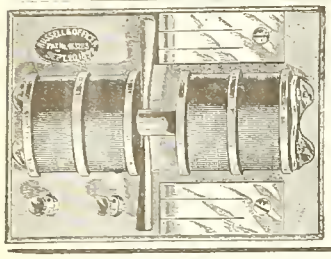

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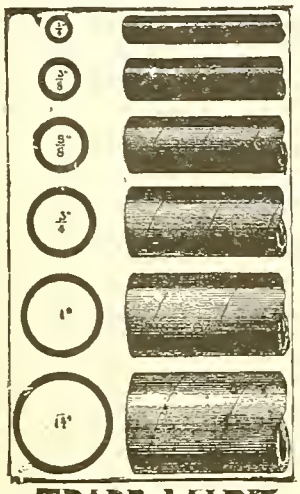

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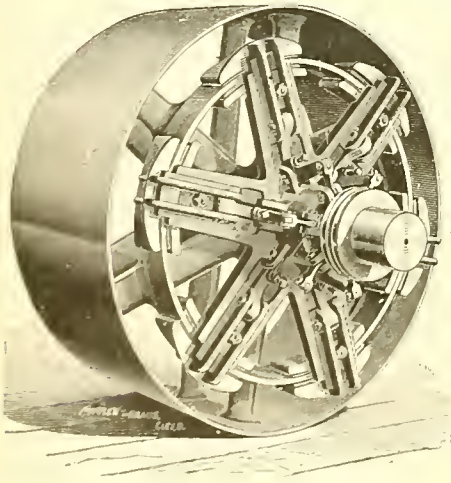

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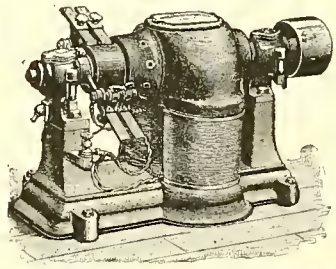

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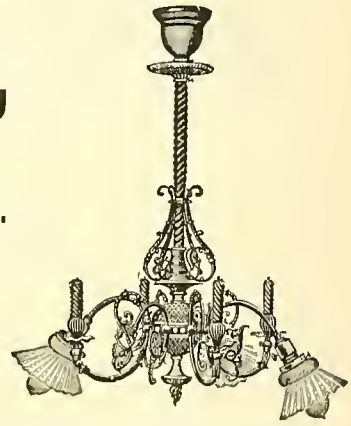

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Ten (10) cents for every burned-out lamp returned unbroken to factory.

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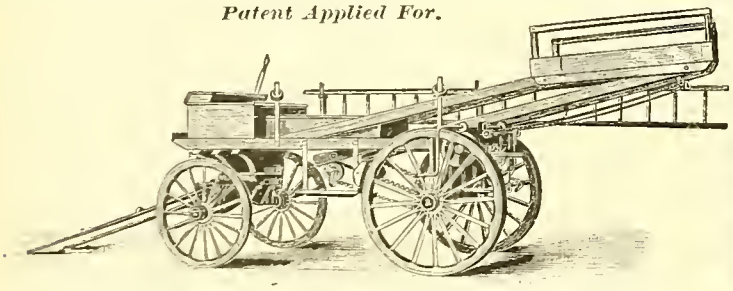

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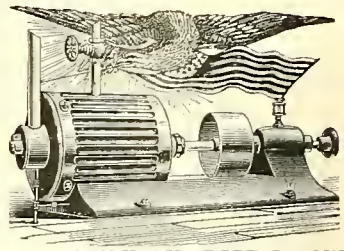

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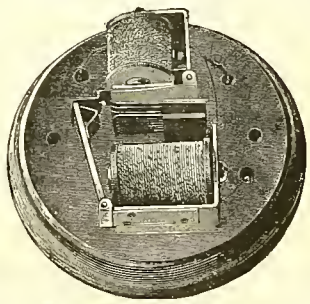

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NOTICE.

January 27, 1893.

To the Electrical Trade:

I have this day assigned the entire interest in the Cleveland Switch, Patent No. 391,512, to THE BRYANT ELECTRIC COMPANY, of Bridgeport, Conn., together with the tools, patterns and moulds for making the Switches and Arc Cut-outs formerly manufactured and sold by THE FOREST CITY ELECTRIC WORKS, of Cleveland (Factory, Geneva, Ohio).

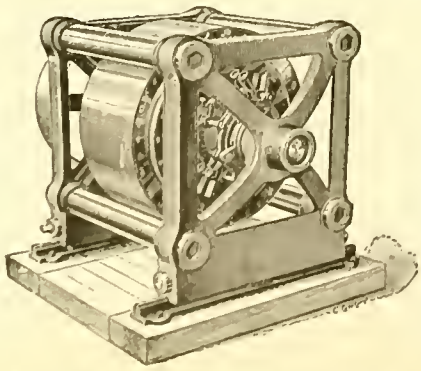
I trust that my former friends and patrons will extend to them the same good will and patronage that they have shown me in the past.

Very respectfully, (Signed) W. B. CLEVELAND.

THE BRYANT ELECTRIC CO. MAKES GOOD GOODS.

The WADDELL-ENTZ COMPANY,

203 BROADWAY, NEW YORK.



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Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, MARCH 25, 1893. No. 12

Elevated Electric Railway at the World's Fair.

The general public, as well as railway men and members of the electrical fraternity, is much interested in the elevated electric railway now nearing completion at the World's Fair grounds One train is now on the tracks, and it is expected that the cars will be running within three weeks. It is believed that the road will then be the second electrically operated elevated railway system in the world, the one just opened in Liverpool, England, being the first. If the line proves as successful as its promotors anticipate—and the indications all point in that direction—the road will undoubtedly be the prototype of many others in the large cities of the country. It is therefore of more importance than a mere method of transporting passengers about the grounds, although that, of course, was the primary consideration leading to its construction in a place where surface roads and the smoke nuisance were tabooed. To all interested in the subject of rapid transit in large cities the intramural road, as it is called, will undoubtedly be the most interesting feature of the exposition.

FIG. 1. ELEVATED ELECTRIC RAILWAY AT THE WORLD'S FAIR.

The road is being constructed by the Western Dummy Railroad company, but it is an open secret that this corporation is merely an offshoot of the General Electric company, which is really behind the enterprise. The officers of the Western Dummy company are: President, B. E. Sunny; secretary, E. C. Ward; general manager, W. E. Baker. The engineering staff consists of C. P. Matlack, chief engineer; C. H. Macloskie, electrical engineer; B. J. Arnold, consulting engineer and designer of power station; R. I. Sloan and G. K. Wheeler, consulting engineers.

The line is three and one-tenth miles long, double tracked, with loop terminals. The north loop is located over the lagoon between the fisheries and the government buildings. From this point the road runs north to the Iowa building in the northeast corner of the park; thence along the north line of the park to Fifty-sixth street and Stony Island avenue; then southward along Stony Island avenue, just inside the park fence, to the transporation annex, crossing over the roof and running alongside of the main transportation building; crosses over the terminal tracks in front of the railway station; swings around the end of the machinery annex, and runs east parallel with and south of it, to the colonnade; from the colonnade the direction is southeast to the forestry building; thence north and parallel with the forestry, shoe and leather and Krupp buildings to the south loop on the bank of the south lagoon, near the Convent of La Rabida. The stations are located at the Iowa building, Fifth-seventh, Fifty-ninth and Sixty-second street entrances, transportation annex, railway terminal station, the colonnade, forestry building and at the loops, making ten in all.

The foundations for the structure are generally concrete, 7 by 7 feet and one foot deep, placed about 4 feet below the surface of the ground. On the lower portions there are two posts framed into a cross-sill, braced at the bottom and fitted into a cap at the top. The posts are a foot square and 12 feet between centers, sill of the same size and caps 12 by 15 inches. The posts and caps are long leaf heart yellow pine; the sills and foot braces are Norway pine. The spans are generally 25 feet except in a few places, where they are greater. In the portion of the line over the roof of the transportation annex two bar columns are used, conforming to the arrangement of posts in the building, and these are 32 feet from center to center. The girders and stringers are of steel and the spans 42 feet, as the line crosses the roof diagonally. The lowest part of the structure allows 12 feet headroom under I beams. The highest is at the transportation annex, where the top of the ties is 27 feet above the floor level. The grades have been designed as far as possible to allow an ascending grade approaching each station. This utilizes the retarding and accelerating effect in approaching and leaving stations. The heaviest grade is 1⅛ per cent., and there are several as high as 1 per cent. On the lower part of the grounds the grade is level with the minimum amount of headroom. Views of the structure were shown in the WESTERN ELECTRICIAN of December 17, 1892, and February 4, 1893. Mr. Matlack planned the elevated structure and track construction, of which he has immediate supervision.

The power house is situated in the southeastern corner of the grounds, south of the forestry building. It is a frame structure, with a back wall of brick through which the flues from the furnaces pass to the smoke stack. The building is now about finished, except a coating of staff. Its present appearance is shown by the picture to the left in Fig. 1. The station and its equipment were designed by B. J. Arnold and were planned for inspection as an exhibit as well as for a working plant. Everything connected with the machinery is massive and constructed in the best manner, although the plant is only a temporary one. Mr. Arnold started out with the idea of making a model station, so far as its temporary nature would admit, and he has succeeded in a manner to enhance his high reputation as an engineer. A plan of the station is shown in Fig. 3, while a longitudinal section is given in Fig. 4 and a side view in Fig. 5. Reference to these drawings will enable the reader to follow more clearly the following brief description.

The boiler room is 140 feet long by 60 feet wide and contains ten 300 horse power Babcock & Wilcox water tube boilers, from which, if occasion demands, a maximum capacity of 5,000 horse power can be obtained. In the rear of the boilers are smoke flues of brick, leading to the stack, which is 100 feet high and ten feet in diameter. Two batteries of Greene's fuel economizers are located outside the building. The water for the plant is secured from the lake, which is about 300 feet from the station, through an 18 inch pipe, flowing by gravity. The condenser pumps take the water from this pipe, force it through the condensers and lift it high enough to give a sufficient head for the water to flow back into the lake through another pipe. The pumps are only required to lift the water about six feet. The feed water will be taken from the hot wells of the condensers, forced by the boiler feed pumps through the fuel economizers and then to the boiler. The hot gases from the boilers will pass through the economizers on their way to the stack, thus heating the feed water to a high temperature before entering the boilers. Oil will be burned as fuel, and a variety of oil burners will be used under the boilers to test the merits of the different apparatus.

The engine room is 140 feet long and 87 feet wide, with a corrugated iron roof. Much care was devoted to the engine foundations, owing to the nature of the soil on which the station stands. The earth was excavated to a depth of three feet below the surface, which is below the frost line. Over this is a temporary grillage work, consisting of two layers of 4 by 12 inch plank, placed at right angles to each other, and thoroughly spiked together. Upon this mass of timber was built a mass of concrete 140 feet long by 60 feet wide and three feet thick, made of Portland cement and sand. Upon this was built the engine and condenser foundations, and it is

believed they will withstand the severe tests put upon them. To have built the foundations in the ordinary manner would have cost double the money expended on the plan adopted. The largest engine, placed in the center of the room, is a 2,000 horse power Reynolds-Corliss cross compound condensing engine, built by the Allis company of Milwaukeee. It is coupled direct to a 1,500 kilowatt Thomson-Houston multipolar railway generator. This dynamo is the largest on the World's Fair grounds, and on account of its great size it was shipped from Lynn to Jackson Park in separate parts. The armature will be wound and the generator assembled in the station. This is undoubtedly the largest dynamo electric machine in the country. The armature shaft alone weighs 65 tons. It is of solid steel 24 inches in diameter. At one end of the building is a 750 horse power Reynolds cross compound engine coupled direct to a 500 kilowatt Thomson-Houston multipolar generator with an over-hung armature. This generator is so built that the fields can be moved off from over the armature by means of screws and hand wheels, thereby permitting easy access to the armature or fields for repairs. Midway between this engine and the largest engine is located a 750 horse power Hammond-Williams compound, condensing, vertical engine, coupled direct to a 500 kilowatt Thomson-Houston multipolar generator. This generator is of the same design as the one coupled to the Allis tandem engine, except that it is provided with an out-board bearing for the armature. At the other end of the engine room is located a 750 horse power tandem cross compound condensing Greene engine built by the Providence Steam Engine company, of Providence, R. I., belted direct to a multipolar 500 kilowat Thomson Houston generator. Between the Greene engine and the Allis engine is placed a 400 horse power tandem compound condensing engine built by the McIntosh & Seymour company, of Albany, N. Y., coupled direct to a multipolar 200 kilowatt Thomson-Houston generator.

The condensers and boiler feed pumps for the entire plant are located in a condenser pit between the engine and boiler rooms. This is left open, with a railing about the top, so that visitors will have a good view of this machinery. Indeed, ample facilities are given for spectators about the entire plant, aisles running entirely around the engine room, as shown in Fig 3. There is also a gallery between the engine and boiler rooms. In this condenser pit will be located two Allis vertical fly-wheel condensers, which are to work in connection with their engines. To the Williams engine there will be attached a fly-wheel condenser built by the Conover Manufacturing company of New York. To the McIntosh & Seymour engine will be attached a single acting condenser built by the Deane Steam Pump company, of Holyoke, Mass. The Greene engine will be attached to a duplex condenser, manufactured by Henry R. Worthington of New York. The feed water for the boilers will be supplied by a triplex pump built by the Gould Manufacturing company of New York and a duplex steam pump built by the Smith-Vaile company, of Dayton, O. The valves for handling the condensers and engines, furnished by the Chapman company, will be controlled by wheels located near the engines, so that the engineers can start the machinery without changing their positions to any great extent. The piping for the plant is all independent of the building.

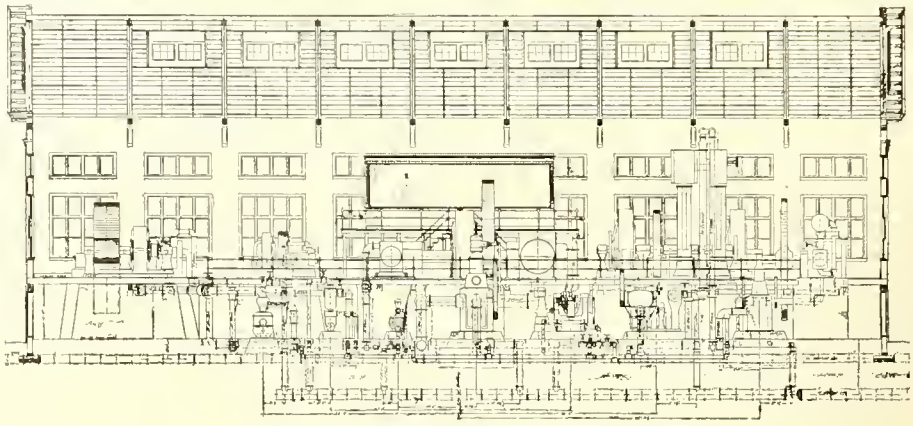


FIG. 4. ELEVATED ELECTRIC RAILWAY AT THE WORLD'S FAIR.

A main header connects all the boilers, from which lead three large steam pipes down beneath the boiler room floor to the engines, branches being taken off at proper points to supply the different condensers and pumps. An automatic pump and drainage tank is located below the lowest point of any of the pipe work and takes care of all water condensation. This pump will force the drainage water back into the boilers, thus doing away with all the traps and waste water in the plant. The switch-board will be located on a half story above the engines, which will permit the electrical operator, who will be located on the switch-board platform, at all times to have complete supervision of all the machinery and electrical apparatus in the plant. The feeder wires will be laid from the power station to the elevated structure in an underground conduit, provided with the necessary drainage and means for access.

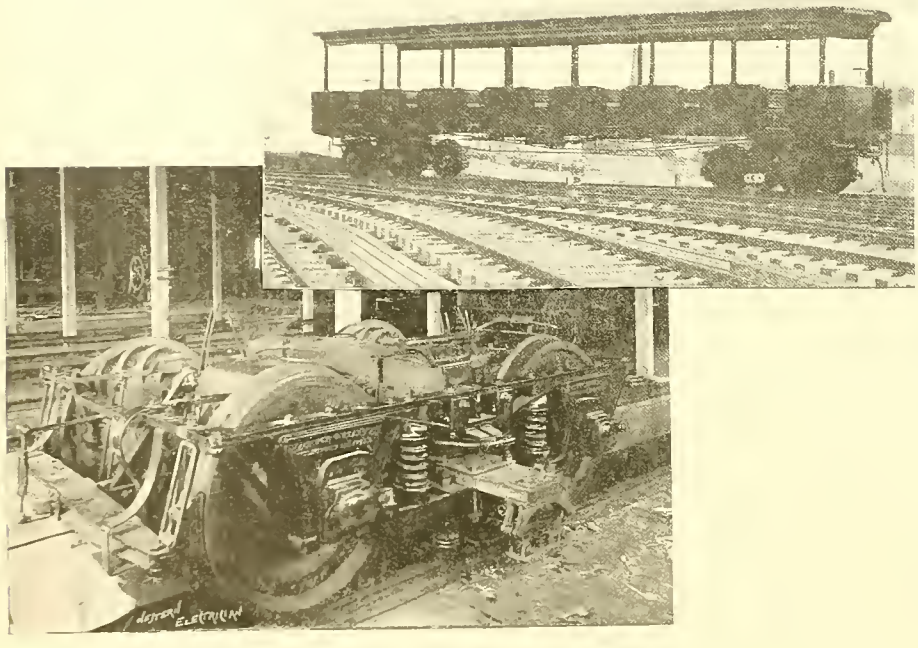


FIG. 2. ELEVATED ELECTRIC RAILWAY AT THE WORLD'S FAIR.

The rolling stock will consist of about eighteen trains, each consisting of four cars, the first car in each train being equipped with four motors. The motors are of a special type, built with the idea of getting up high acceleration in short distances. The motors have nominal horse powers of about 133 each, making a total of 532 to each train. The cars are to be controlled on the series-parallel principle, the motors being placed in series at the start and gradually thrown into multiple. The cars are equipped with the New York air brake, of the latest approved design, and will stop the train at its highest speed in about 400 feet. They are 47 feet long, and each will seat 96 people. A picture of the car is given in Fig. 2.

The conductor for carrying current from the power station to the trains consist of a 60-pound steel T rail, similar to those used for the tracks, mounted on insulated blocks and placed outside the track. Each rail is connected to each succeeding rail through two copper plates riveted through the splice bar holes, the splice bar being omitted. The current is carried from this rail to the car by means of a sliding copper shoe, which rests on the top of the rail and is held in contact with it by a spring. This trolley arrangement is shown on the truck, which is represented in Fig. 2. The current is returned through the iron structure, passing from the track to the iron girders through a copper wire, and then from girder to girder through heavy copper plates rivcted to the webs. Mr. Macloskie has charge of the electrical engineering.

FIG. 5. ELEVATED ELECTRIC RAILWAY AT THE WORLD'S FAIR.

The cars will be brilliantly lighted with incandescent lamps, and will present a fine appearance at night. The cars themselves are open. Doors are placed at the side and can be opened by means of one lever from the end of each car, so that when the trains come to the stations all the doors on one side of the train can be opened instantaneously to unload passengers and take others on; as soon as the train is loaded the gates can be closed again, by means of the levers in the ends of the cars. The car house and switching tracks, shown at the right in Fig. 1, are just west of the power house.

The road is equipped with the Rowell-Potter Safety Stop company's block signal system, which, besides having a visual signal, has also an automatic arrangement for throwing on the air brakes, in case the engineer runs over a signal. This will insure the greatest possible safety from collisions.

The cars and trucks were manufactured by the Jackson & Sharpe Company, of Wilmington, Del. The motors and electrical equipment were especially designed for the purpose by the General Electric company of New York. The wheels and axles were furnished by the Griffin Wheel & Foundry company of Chicago.

It is expected that the round trip will be made in forty minutes stopping at all stations, at a headway of a little over two minutes. The fare will be ten cents, and tickets will be deposited in choppers, as on the New York and Chicago "L" roads.

Chicago Electric Club.

Following is a stenographic report of the discussion of Charles G. Armstrong's paper before the Chicago Electric club on "Electric Installations and Some Radical Change in General Wiring," which appeared in the last issue of the WESTERN ELECTRICIAN:

ALEX. DOW: I wish to indorse Mr. Armstrong's views on the possibility of radical changes in wiring methods. I think that we are following telegraph practice altogether too much in separating the wires. The conduit system which permits us to bunch cables underground, not only of different polarities, but from different machines, and even from different central stations, should permit us to bunch wires in interior work. Mr. Armstrong suggests that feeders and risers should have stronger insulators in buildings. I think that is unnecessary and objectionable—unnecessary because the same insulators are allowed to be laid in plaster or in brick that are required in risers and feeders, and objectionable because they take up too much space. I think that feeders and risers in elevator shafts should be inside of iron pipes, and that probably the best thing for the purpose would be an Edison tube, arranged for use in a vertical position. The use of a small conduit is exactly what we want. Mr. Armstrong has called attention to the fact that in view of the present practice of using only a half inch of plaster a large conduit or wire is out of the question. I cannot entirely endorse the use of moulding. It is expensive work, and it is objectionable in that it furnishes inflammable material just where it will greatly aid the progress of a fire. I think that moulding might be eliminated altogether from the problem by the arrangement of risers as I have suggested in a pipe and interior conduit in the last step of running into an office.

THE CHAIRMAN: We have had in Chicago a great deal of trouble due to risers in elevator shafts. The ordinary mechanic is very likely to do a great deal of mischief in those places, but aside from that the plan formerly adopted of fitting up a wooden wall for those risers, and then putting them on it without cleats or even insulators made a perfect leader for fire from the bottom of the elevator shaft to the top, in case of a conflagration.

MR. WARNER: Regarding Mr. Armstrong's suggestion to bunch large numbers of wires of the same or opposite polarities, it should be remembered that while there may be little or no danger in two or three wires of opposite polarity being bunched, it seems to me that there should be a limit for safety. Wires have been known to break owing to contraction or expansion, and to break somewhat suddenly at times, and arcs formed. Under these circumstances the arc might burn and injure all the other wires in the conduit.

MR. BUSHNELL: A great deal of our wiring has to be done in old buildings and in entering a building already constructed there are two classes of work which we can do and which will present an attractive appearance, namely fish work or moulding. Now in the case of fish work the wires must necessarily at one time or other be together, and as a matter of experience I have found that fires caused by the wires being together have been much more frequent in moulding work than in fish work.

L. A. FERGUSON: I am very glad that Mr. Armstrong called attention to the bunching of wires. I think it is the first time that the question has ever been discussed in the Chicago Electric club. About two years ago I had some experience with electrolysis, and the question of putting the two poles together struck me very forcibly, and after thinking the matter over carefully I concluded that it was the best thing to do. I have always since recon

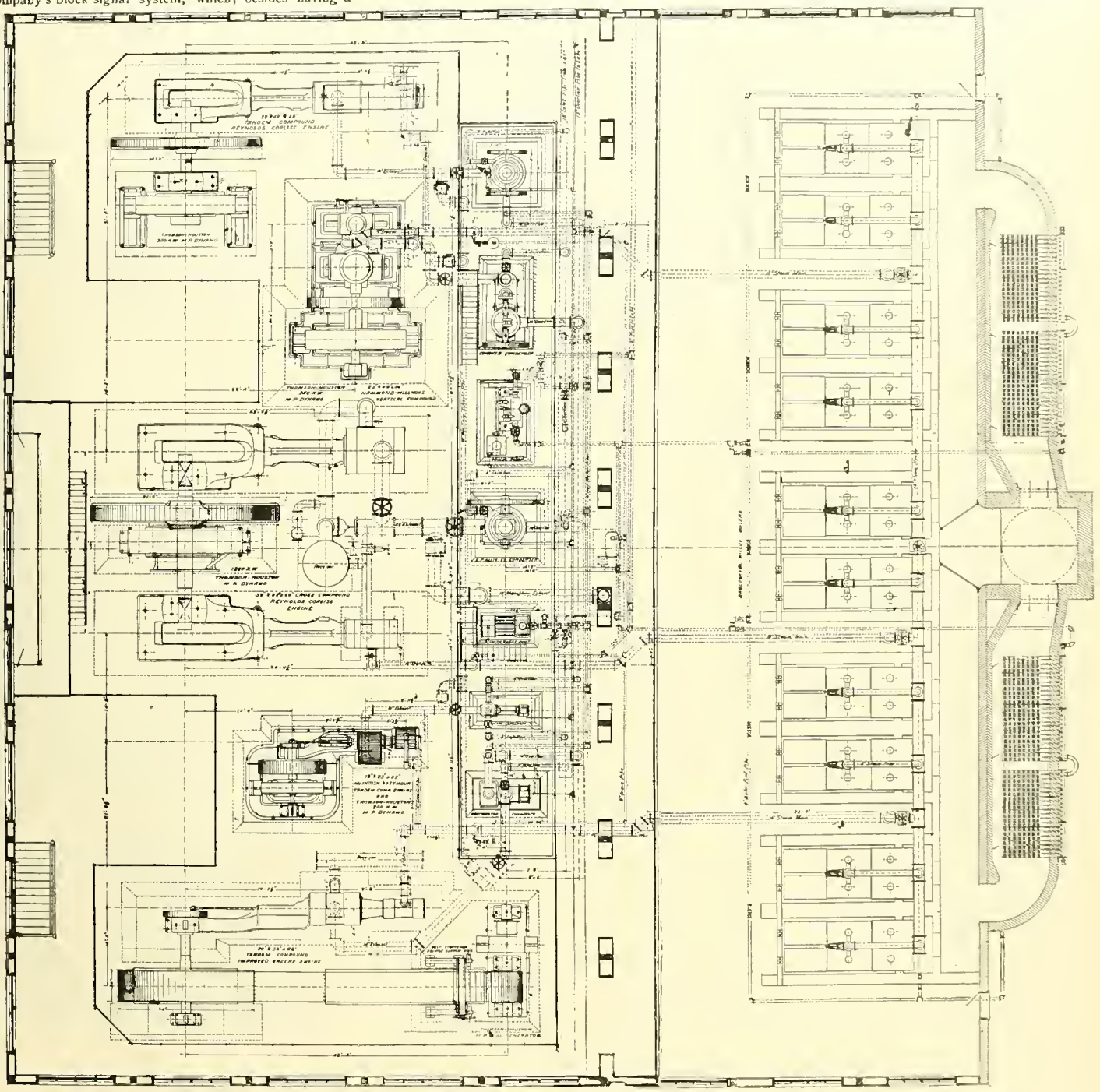
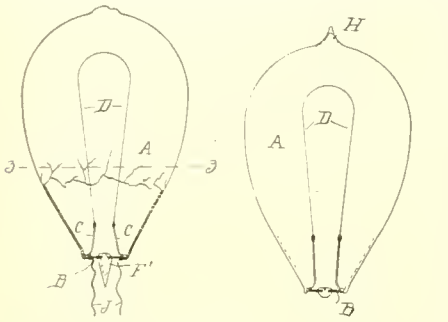


FIG. 3. ELEVATED ELECTRIC RAILWAY AT THE WORLD'S FAIR.

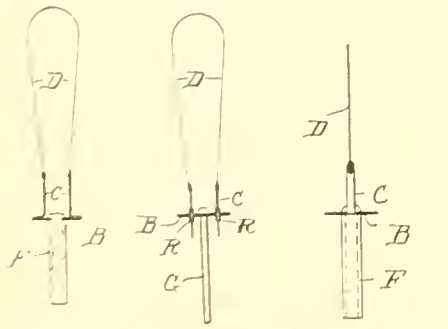
mended it; but we have been unable to do it to a great extent because of the city rules, which are the same as those in force all over the country, I believe, and I hope with Mr. Armstrong that before very long Chicago will take the lead in having a rule passed that will allow the running of wires of opposite polarity together rather than to separate them. I think that most of the rules that govern the electric installations in cities are based upon those drawn by the insurance companies, which, taken as a whole, cannot be fulfilled, principally for mechanical and architectural reasons. There is no question at all but that it is much safer to run two distributing wires of opposite polarity together than to separate them. The greatest difficulty we have in wiring is electrolysis. The only way to avoid the evil effects of electrolysis is to put the two poles together. If the system is properly designed, fuses properly installed, and of proper size, there is no danger. I think this matter is especially important in buildings that are not fire-proof, where the material between the two poles, if the wires are separate, is inflammable. If you have a ground on one pole of the system, and the other pole becomes of low insulation, the electricity passes between the two poles, no matter where the ground may be, and in passing from one pole to the other the wire becomes gradually drawn down to a fine point and an arc is formed. The fuse dose not take any notice of the arc at all, the current is carried along the line and the building is set on fire. Now when the wires run side by side and electrolysis takes place, there



FIGS 1 AND 10. INCANDESCENT LAMP WITH METALLIC BASES.

being nothing between the wires except rubber, after the current has passed for a certain period of time, the wires become short circuited, the fuses blow out and the building is saved. It is not only theoretical but it is absolutely practical. There is one little point that seems to me to be very much neglected in electric insulation on switch-boards, and that is the protection of the galvanometer circuits, and the volt meter circuits. I don't know why it is, but nine out of ten switch-boards that are built have their galvanometer and pressure wire circuits unprotected. Throughout the plant the best of cut-outs may be put in, but when it comes to the switch-board nothing is put on. As a rule there is nothing back of the wires, so that if a short circuit takes place behind the board it is bound to burn up. I have known this to occur in several instances in Chicago.

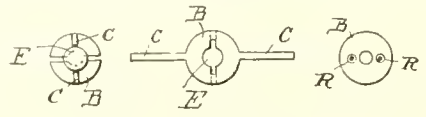
Mr. Armstrong puts the limit of current on circuits at eight amperes instead of five. I think the rule of five amperes is too low, much too low. No. 14 Brown and Sharp wire will carry safely sixteen amperes. But it is not a question of carrying capacity wholly but of the burning out of sockets. I believe that twenty lights on a circuit where the lights are in the ceiling and controlled by a wall switch is much safer than six lights on a circuit where they are on drop cords with key sockets, for the simple reason that when you have twenty lights all in the ceiling all the lights must burn at once, the fuse is at high temperature at all times, and it takes but slight increase in the current



4 7 AND 9. INCANDESCENT LAMP WITH METALLIC BASE.

to blow the fuse. You will find that a socket is seldom burned out, but on a tap line with drop cords the sockets are very often burned out. This is explained by the fact that there may be only one light burning on the circuit, the fuse is cold, and it is quite a time before the fuse burns out, and in that time the socket will be destroyed. There ought to be a limitation made so that the number of lights on the circuit and the number of amperes on the circuit should be governed by the conditions, and the wiring law made in such a way that the number of incandescent lights controlled by a wall switch should be at least twenty on a circuit. I think that is something that ought to be left to the electrical inspector and that he should not be bound by absolute law. In regard to the connections on the switch-board, I am a firm believer in making all the connections on the front of the switch-board.

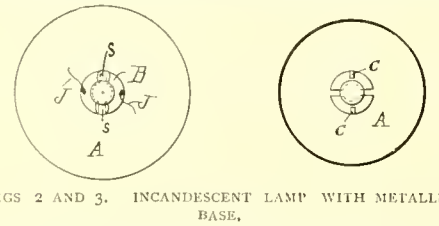
The first reason for that is that if you allow a contractor to make connections behind the board the chances are that the work will be done in a very slip-shod way. I have been behind switch-boards that looked very well in front, but I would not recommend them to run safely for any length of time. None of the connections were soldered; wires were bound down by pieces of brass, where the contact perhaps of a No. 0000 cable was not more than a single strand of the cable. But if the connections are made on the front of the board the contractor can see at once the condition, and appear-



FIGS. 5, 6 AND 8 INCANDESCENT LAMP WITH METALLIC BASE.

ances alone will induce the contractor to makea fine job. In regard to systems of wiring I believe that the loop system of wiring, such as is used very extensively in Chicago, is the best system; the one in which there are no joints beneath the plaster. The greatest advantage in the loop system is the facility offered for testing. Where the loop system is used it is a very easy matter to go from one room to another and test between fixtures, but if the joints are behind the plaster you have to cut into the wire to test. On the loop system you can cut and try anywhere, without damaging the plaster at all. In the average fire-proof building in Chicago there is no reason why the architect cannot provide a place in which to run the risers, and I think a pipe shaft is much the better place to run them, because after the work is once done it is very seldom any one has to go in there, and the wires can be run at high temperature there and are always easily reached on each floor, provided a proper opening is made into the pipe shaft.

Mr. Armstrong said that he did not like to drive dynamos in tandem. I think he is quite right. I do not see any reason for it except in arc light plants. There is one thing that a great many people seem to lose sight of, that is that the economy in the operation of electric light plants depends more on the engine than it does upon the dynamo. In a well designed dynamo the fall in economy should not exceed ten per cent. from full to quarter load, whereas in the engine it may amount to from thirty-five to fifty per cent. I know of a plant in Chicago designed by one of the best steam engineering companies in the United States where they put in a 200 horse power Corliss engine driving two 45 kilowatt incandescent and one 20 and one 30 light arc machines. The engine drives to a jack shaft, and from there drives to another shaft, and that shaft runs at a thousand revolutions a minute. It makes so much noise that it is absolutely impossible to hear a man talk in the room, and that 200 horse power engine runs during the day at one-eighth load. Now the electric part of that plant was divided up in order, presumably, to save expense



FIGS 2 AND 3. INCANDESCENT LAMP WITH METALLIC BASE.

of operation, into two 45 kilowatt dynamos, because the load was going to be light during the day; they put in a 20 and a 30 light arc dynamo, because they might want to burn a few arc lights during the day. In that plant, on the other hand, they might have put in two engines, and one arc and one incandescent machine, and run the whole thing with much better economy.

Incandescent Lamp with Metallic Base.

Recent decisions of the United States courts in the incandescent lamp litigation have served to revive interest among inventors in this line and many expert lamp makers have been engaged in devising a form of lamp that would not infringe the Edison patent. One of the results of recent experiments in this line is the lamp perfected by John Von der Kammer of Chicago, the principal features of which are herewith illustrated. It will shortly be placed on the market.

In this lamp the use of leading-in wires is obviated by the substitution of a metallic base plate. The inventor claims that where in-leading wires are used much trouble is experienced, as the in-leading wire must pass through a considerable length of glass, or be surrounded by and fuse into glass along a considerable portion of its length in order to make a tight seal. This involves having considerable glass at the base of the lamp, through which the wires can extend. These leading-in wires and conductors which pass through the glass are made of platinum, a costly metal, and in the shape of conductors leading through glass, or platinum conductors, it is very difficult, if not impossible, to recover the metal for successive use, and when recovered, it must be refined, and again drawn into wire. As a substitute for these small in-leading wires and conductors passing through the glass comparatively large masses or plates of metal are used, which form a portion of the globe or receiver, being secured only along the edges, so that the metal can be recovered in the form of plates or masses again and again without being refined, and hence without loss or deterioration. These sheets of platinum or plates of platinum are shaped and applied at the base of the receiver or globe so to dispense with the seal pieces, stems, glass tubes and glass wire supports commonly employed, and the inwardly projecting portions of glass. This metallic base also obviates the necessity of sealing or fusing glass upon glass, as in the ordinary form of constructing an incandescent lamp. Where this latter process is followed the two portions of glass brought together to be fused will have interposed between them foreign substances which render a good seal difficult, and involve a certain percentage of loss of lamps in the process of manufacture. The sealing of the metal base upon or into the glass globe, it is claimed, makes it easy to obtain a safe and satisfactory vacuum bulb, for the reason that the glass being brought around or over the edge of the disk or base plate which forms a part of the bulb or receiver may be fused on the metal so as to form a safe seal.

In the accompanying drawings Fig. 1 is a side view, partly sectional, of a lamp containing the metal base portion of the bulb or globe. Fig. 2 is a bottom view of the bulb with wires attached. Fig. 3 is a horizontal section on the line 3 3 looking downwardly. Fig. 4 is a side view of the

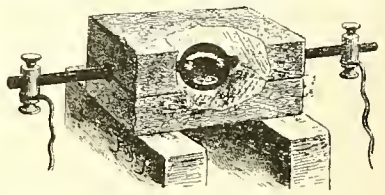
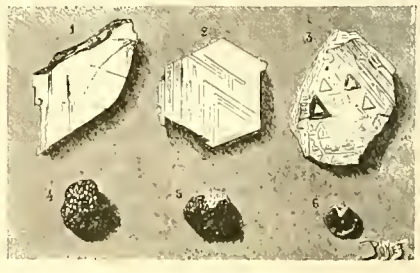


FIG. 1. ATTEMPTS AT DIAMOND MAKING.

bottom plate and the charging tube on which it is fixed, and the filament. Fig. 5 is a plan view of the bottom plate with filament removed. Fig. 6 is a plan view of the base plate punched out ready for use. Fig. 7 is a side view of a modification of the base plate and attached parts. Fig. 8 is a plan view of the modified base plate. Fig. 9 is a side elevation of the device shown in Fig. 4. Fig. 10 is a view of the lamp bulb completed with the exterior wires removed. *A* is a bulb formed in a part of glass, and in part of metal. The lower metallic portion or base *B* is preferably divided into two parts, as indicated. It may have two upwardly-projecting terminal strips *C C*, to which the ends of the filament *D* may be attached. The base plate *B* and the arms *C C* are preferably stamped out in a single base plate, but when applied to the lamp these two portions are separated. *E* is a hole or aperture through the plate. The base plate may be secured upon the tube *F* or stem *G*, according to the manner in which it is to be applied to the lamp. If the tube *F* is employed, the lamp globe may be discharged or charged through the tube; but if the stem is employed, the charging and discharging may take place through the top of the globe as at *H*. When the tube is used, after the lamp is completed, it is fused off as at *F'*. *J J* are the exterior wires, which may lead to the metallic base, though any desirable connection can be made. The lamp or globe may be charged with gas,



1 and 2. White diamonds obtained by Moissan, magnified 500 times.

3. Natural white diamond, magnified 300 times.

4, 5 and 6. Black diamonds obtained by Moissan, magnified 200 times.

FIG. 2 ATTEMPTS AT DIAMOND MAKING.

although the features of construction shown may be employed in connection with a vacuum globe.

The metal sheets are substantially at right angles to the glass portion of the receiver wall at the point where they are fused together. The base is composed of two substantially equal parts of metal connected by the glass pieces or portions *S S*. The whole is mounted upon a glass stem or tube. This base is inserted in the lower end of the receiver, which is slightly prolonged and is made to fit snugly with the receiver. The lower end of the receiver is then fused against the edge of the base, which is almost at right angles to the inner surface of the receiver, and the lower portion of the receiver is fused around the edge so as to extend to the outer surface of the metal of

the base. Conductors may be employed, beingled through apertures in the base plate, the base plate in that case forming one continuous metallic portion, and the conductors leading through it being surrounded by glass tubes *R R*. When the base is composed of two or more separated sheets, metallic conductors might be led through them each fused upon a metal sheet. When the plate metal is to be recovered, the glass portion may be broken off near to the edge of the metal, the base part may then be heated and dipped in water, when the glass will separate from the metal, and the metal plates will be ready for use. The filament and the exterior conductor or wire may be connected with the metal plates in any desired manner. In Fig. 1 a lamp which has been exhausted from the bottom is shown, and in Fig 10 one that has been exhausted from the top. In either case the fluid inserted is introduced at the point of exhaustion. When a metal base is used with conductors which pass through them and through bits of glass embedded in the metal base, the latter may be of a single sheet or plate; but if the conductors are in metallic contact with it, the plate should be divided into two parts.

Attempts at Diamond Making.

French scientific journals have of late contained many articles relating to the researches made by Henri Moissan by means of the electric furnace. His work has been of both an analytic and a synthetic character, and he has produced results of great scientific interest. One branch of his experiments has especially appealed to the popular imagination, and has been made the subject of articles in more than one non-scientific periodical. Moissan himself speaks of these investigations as experiments with carbon under great pressure, but the enthusiastic popular writers go the length of styling his work diamond making. The discovery of a mode of producing an actual diamond has been the dream of many a romantic scientist, but the search for it does not by any means belong to the order of experiments which had for their end the production of the philosopher's stone. Theoretically, the making of a diamond is not such a formidable undertaking; practically, however, it has proved impossible, and all attempts to counterfeit nature have proved fruitless, at least up to the present time.

Moissan, according to popular reports at least, has been one of the dreamers who hoped to solve this interesting problem. He began his work by studying the blue earth from South Africa, which is so rich in diamonds, and he

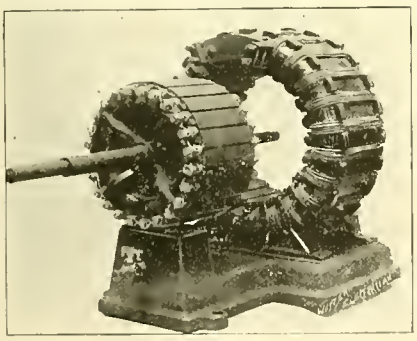


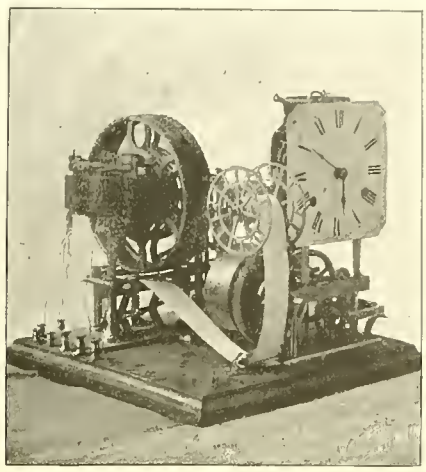
FIG. 1. SINGLE PHASE ALTERNATING MOTORS.

was struck by the fact that iron or its derivations formed an important constituent. At the same time he learned of the finding of a diamond in a meteorite called Canon Diablo, which he regarded as a significant fact. He next amused himself during four years by burning diamonds at an expense of several hundred dollars. He found, as others had, only that they are carbon crystallized in almost a pure state, but he also determined, after examining the results of combustion, that even the purest stone contains traces of iron. He came to the conclusion that nature made diamonds by employing iron in some way at high temperatures and under tremendous pressures. This was really the starting point in his experiments.

To attain the high temperatures necessary for the work the electric furnace was essential, and the type used by Moissan was the simple form shown in Fig 1. It consists of two bricks of refractory material, one resting above the other. The lower brick is grooved so that carbons may be introduced into a cavity, hollowed out in the center where the crucible rests.

Cast iron when melted possesses the property of dissolving a certain amount of carbon, and like silver, it expands in volume when passing from fusion to a solid state. With this prefatory remark, the plan which Moissan followed can be best explained in the language of a paper which he recently read before the Academy of Science:

A quantity of carbon obtained from sugar is compactly pressed into a soft iron cylinder closed by a screw cap at the end. We melt in the electric furnace a quantity of soft iron, varying from 150 gr. to 200 gr., which requires only a few minutes time. Then into this bath is introduced the cylinder containing the carbon. The crucible is immediately taken from the furnace and placed in a bath of water. We thus cause the sudden formation of a layer of solid iron, and when the crust becomes a dark red, we



TODD'S ELECTRICAL RECORDER.

take the crucible from the water and let the cooling continue in the air.

Moissan also makes practically the same experiment by substituting silver for the iron.

The conditions which obtain are these: When the molten medal is dropped into the cold water, an outer shell is formed, but the internal portion is still almost molten. In regaining its solid state, it expands in volume but meets a stout resistance from the fixed outer shell. As a result, great pressure is brought to bear on the dissolved carbon returning to the solid state.

After the metal is thoroughly cooled, acid is employed to separate it from the carbon. In the case of the silver, which is treated with nitric acid, there are found round grains of black carbon of great hardness and extreme density. The specific gravity ranges from 2.5 to 3.5, that of graphite being 2. This is the black diamond or carbonado.

When the iron of the other experiment is removed by hydrochloric acid, there are obtained small crystals, microscopic it is true, and in very small quantities. Some of these are black and others transparent; the former are identical with certain kinds of carbonado. Their density ranges from 3 to 3.5. These transparent grains, Moissan says, present all the characteristics of the diamond. They have the same crystalline form, the play of prismatic colors is the same, the specific gravity is the same, 3.5, and the same result is found when they are burned. Berthelot, who discussed the paper in which Moissan presented these facts said he had been working in this field, but the success which had attended the latter's experiments proved that it was unnecessary for him to prosecute his own researches. It is almost unnecessary to add, in view of the description that has been presented, that no industrial significance as yet attaches to Moissan's achievements in diamond making. It is not safe to make predictions, but there is probably no immediate danger that the price of diamonds will be materially lessened.

Todd's Electrical Recorder.

The accompanying illustration shows an ingenious piece of mechanism that was designed by John T. Todd, secretary and treasurer of the Columbia Manufacturing & Supply company, Chicago. The purpose of this device is to record at a distance at certain intervals of time variations of temperature, steam pressure, etc.

The invention consists essentially of a transmitter and recording instrument electrically connected and operated by an open circuit battery.

The transmitter is so arranged that for each degree of variation of temperature or of steam pressure, the electric circuit is closed. By means of the current a corresponding variation and record is made in the recording instrument, which may be located at any desired distant point.

The recording device proper consists, as will be readily seen, of three or more type wheels, one of which represent, by numbers the degrees of temperature or the pounds of steam pressure. This wheel is controlled by the electric impulse received from the transmitter and the other two wheels have type to represent the days of the week, and the hours of the day subdivided as desired. These two wheels are operated by a spring motor and are under the control of an ordinary clock movement. This clock movement is so devised that it releases the printing mechanism at certain intervals, causing the day of the week, the hour and minutes and the state of the temperature or steam pressure to be plainly printed on a ribbon of paper which is automatically fed under the printing wheels. The recorder is provided with an alarm bell operated by the electric current which gives an alarm if the force to be recorded rises above or falls below any desired points.

A feature of Mr. Todd's invention is that by the adding of any number of temperature wheels the temperature of any number of rooms may be printed at the same time by the one instrument; of course, though, a separate transmitter would be necessary for each room or point from which indications are desired. Another feature that can also be employed is an automatic switch operated by the rising or falling of the temperature or other force, whereby the poles of the battery are reversed by this action. Through the use of this switch only one wire is required to connect the transmitter and recorder, and the expense of wiring when the instruments are distantly located is, therefore, considerably reduced. This electrical recording instrument invention will be exhibited at the World's Fair.

Single Phase Alternating Motors.

BY A. W. MESTON.

In a late issue of the WESTERN ELECTRICIAN there appeared an interesting description of a motor for single phase alternating currents by C. E. L. Brown. It was of more than usual interest to the writer as being an almost exact account of a series of experiment carried on by him for some time past, in this new and fascinating field of electrical discovery. It is not with any intention of belittling Mr. Brown's discoveries, or of claiming precedence over them, that this statement is made, but more with a sincere feeling of gratification, to find that one so intimately connected with advanced work in this direction is traveling the same path.

The cuts here presented show several forms of the apparatus used, taken from photographs of the originals. Fig. 1

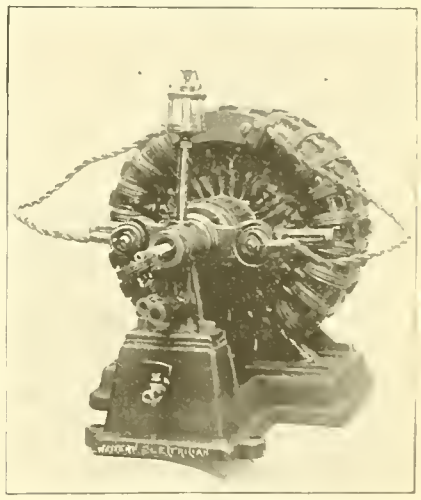


FIG. 2 SINGLE PHASE ALTERNATING MOTORS.

is a motor with embedded field windings and short-circuited armature bars. Fig. 2 is a starting motor with similar field winding and a special form of armature with commutator. This is utilized in starting and bringing to speed the motor shown in Fig. 1. The two forms have not as yet been combined, as suggested by Mr. Brown.

Notwithstanding the evident identity in the forms of apparatus with those operated by Mr. Brown, the writer has heretofore been unable to obtain results so satisfactory as those described by him, which is no doubt due to the fact that the frequencies used have been higher. In his article Mr. Brown does not mention what frequencies he employed, so that no comparison can well be made.

The Nassau Electric Railway company of Brooklyn has been incorporated. The company is capitalized for $6,000,000, and will operate a double-track street surface railroad for a distance of twenty seven miles. The directors are P. H. Flynn, George Damon, George S. Studwell, Fred C. Cochen, J. B. McQuillan, William J. Studwell, Silas B. Dutcher, Brooklyn; James F. Casey, Albany; and F. H. Johnson, New Utrecht.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE more the people of New York look into the plan submitted by the Rapid Transit Commissioners the less they like it. It is denounced by the Manhattan company—probably because it does not grant all the privileges that corporation demanded—by the people who see that it does not solve the problem, and by the city officials who say they will not approve any proposition that does not provide for some pecuniary return to the city for the privileges granted. At present the outlook for rapid transit in New York is not favorable.

EVIDENTLY the Illinois Legislature dislikes to acknowledge its inability to sand-bag the telephone and telegraph companies operating in this state. At Springfield a measure providing for imposing a tax of 3 per cent. on the gross receipts of telegraph, telephone and insurance companies has been under consideration for several weeks. When the bill was introduced it was pointed out by eminent legal authority that it was unconstitutional, yet the Legislature devoted considerable time to discussing the features of the measure and making speeches against corporations, which can be used for political effect when the members desire re-election. The bill was first sent to the committee on corporations, then to the committee on judiciary, and as neither of these committees would report favorably it was finally saddled upon a special committee. Just how much time this senseless measure will occupy cannot now be estimated. Certain it is that the members of the Legislature know they are wasting valuable time as long as they devote their attention to this bill, but on the whole it may be just as well for the people of the state, as they might be doing more harm if they did not occupy themselves considering this ridiculous measure.

AFTER the telephone there is probably no invention in the electrical field that has attracted so much attention as the telautograph. It is certainly a marvel of mechanical art, and while it may not occupy a place in the commercial world as important as the telephone, it is a valuable addition to the achievements of electrical inventors of the present age. A more appropriate time for presenting this invention to the public than the present could not be selected. The telautograph will form one of the greatest attractions at the World's Fair. It is worthy of note that its inventor, Prof. Elisha Gray, of Highland Park, Ill., occupied a position of considerable importance at the Centennial exhibition by reason of his claim to the invention of the telephone. The telautograph is a much more perfect instrument to-day than the telephone was when displayed at Philadelphia. The exhibition of the telautograph at Chicago and New York on Tuesday last, and the successful operation of the instruments on a line between Highland Park, Ill., and Waukegan, Wis., marked the opening of a new field of electrical activity, and one in which there is much promise. Prof. Gray is to be congratulated upon the success which has attended his investigations and experiments in this line and the general recognition they have received.

THE wonderful perversity of human nature is illustrated the attitude of legislatures, city councils, and in some cases, unreasonable communities, toward the electric railway. It was to be expected that the steam railroad companies, feeling the effects of the competition of the electric lines, would endeavor to retard the advancement of the latter, but it was not thought that legislatures would evince such a willingness to serve the steam railroads as has been displayed in Connecticut and New Hampshire. In Milwaukee and St. Paul the local companies have been hampered by the city councils, and in the former city by the opposition of a portion of the people. The Milwaukee company has been peculiarly unfortunate. Its system has been crippled by fires and other accidents which could not be averted or provided against. Yet in the midst of this trouble, and while the company is spending thousands of dollars on its plant, the patrons are placing obstacles in its way. The company has been obliged to consider the advisability of discontinuing operations on several improvements and extensions. This would certainly prove unfortunate and it is to be hoped that the unreasonable opposition of the residents will cease before the company is driven to extreme measures. The controversy in St. Paul is equally exasperating and President Lowry has announced his willingness to forfeit his franchise in that city rather than comply with the demands of the council.

IN view of the stress that has been made upon the "all glass globe" feature of the Edison patent in the recent incandescent lamp litigation, it will be of interest to lamp makers and the trade generally to know that an incandescent lamp has been patented and will probably soon be placed upon the market, in which the inventor claims to have devised a lamp with a metallic base which not only does not infringe the Edison patent but is an improvement on the old form of lamp. This new lamp is illustrated and described elsewhere in this issue. In the Edison patent the second claim reads: "The combination of carbon filaments with a receiver made entirely of glass and conductors passing through the glass and from which receiver the air is exhausted." Commenting on this feature of the Edison patent Judge Wallace in his opinion, which was published in the WESTERN ELECTRICIAN July 25, 1891, said: "The second claim is broad enough in its phraseology to secure the real invention described in the specification, and can be read consistently with its language so as to impart into it every essential limitation."

An examination of the claims made by the inventor of the new lamp will show at once that it has been his aim to produce a lamp that would not infringe the Edison patent. Its development at this time will create new interest in the lamp controversy which has occupied so much attention during the last year. The development of the new lamp will be closely followed by the entire electrical fraternity.

A WIREMAN writes to the WESTERN ELECTRICIAN to urge the necessity of the employment of good men at good wages in the electrical construction business, for the benefit of all concerned. We sympathize with much that he says about the discreditable effect of the botch work performed by incompetent wiremen, and agree that contractors will in the end find it to their advantage to employ good men at a fair rate of wages. It is true that in the past the reputation of the electrical business has suffered in many instances by the wretched bungling that has been placed in buildings under the name of wiring. With improved station and line construction the standard of wiring has been raised, and now cases of dishonest and defective wiring seldom occur, although they are not altogether unknown. Any effort to better the general average of work deserves the hearty support of all who have the welfare of the industry at heart, and we are, therefore, in favor of the payment of just wages and the employment of none but first-class workmen. The trouble with the trade unions is that all the members are not good mechanics, and it is therefore unjust to make a uniform price at the rate to which the best men are entitled. This was strikingly demonstrated by the trouble at the World's Fair. The wiremen there demanded 37½ cents an hour instead of 31½ cents. The authorities were willing to pay the former price for good work, but insisted on the right to discharge incompetent men. After several conferences this condition was acceded to by the union, and many of the old men were taken back under this arrangement. This is precisely as it should be—good work at good prices. Let employers and employed both adopt this maxim—and it is surely to the interest of both—and we shall hear fewer complaints of improper wiring.

IT is interesting to note that the case of the National Telephone company against Graff Baker, which was tried in Leeds, has been decided in favor of the defendant. This was the first English case in which the relative rights of telephone and electric railway companies, both using earth returns, were judicially determined, and, as in the United States, the electric railway was held to have the better claim.

The action was brought by the plaintiff company, which is using its exchange system at Leeds, to restrain the nominal defendant, who represented the Thomson-Houston International Electric company, and has recently constructed an electric tramway in Leeds, which is under the control of the corporation, from committing an alleged nuisance in the working of the tramway. The nuisance complained of was caused by electrical disturbance, the electric cars affecting, it was said, the telephone wires to such an extent as to prevent the plaintiff's subscribers from communicating with one another, and the question was whether the plaintiff could prevent the defendant from causing this natural electrical disturbance to the prejudice of its telephonic system. The point raised by the action was an entirely novel one in Great Britain, although it has been much discussed in this country. The judge held that the defendant was not responsible to the plaintiff for the mischief caused by his railway. Of the contention that by the adoption of other than the single overhead trolley system the defendant might obviate the nuisance complained of, the court says:

> My conclusion from the evidence is that the defendant's system is, on the whole, the best which practical science has yet discovered, but there is no occasion really to go as far as this. It is enough to say—and about this I entertain no doubt—that it is at least as good as any other, and has been proved by experience, especially in the United States, where there have been larger opportunities for experiment and consideration, to be as likely as any other to meet the requirements of traffic and the convenience of all concerned in the protection of the site of tramways for the use of legitimate purposes other than those of the tramway undertaking.

This decision has attracted wide attention in England and is generally approved. It appears to be founded on good law and good sense. In his opinion the judge says that the decisions of the American courts have commanded his "earnest attention and respect," and, although he does not accept them as precedents on account of differing interpretations of a technical point of law in the English and American courts, he nevertheless arrives at the same conclusion by a different process of reasoning.

Elisha Gray's Telautograph.

On Tuesday, March 21st, the first public exhibition of the telautograph was made at Chicago and New York. Representatives of electrical journals and the leading daily newspapers of the country were present and they inspected the machines and witnessed their practical operation. At Chicago the exhibition took place in the Home Insurance building. An exchange system had been fitted up, comprising a central office and several subscriber's stations. The central office outfit consisted of a subscriber's outfit and switch board, the latter resembling a small telephone exchange switch-board. A subscriber's outfit comprises two machines, a receiver and a transmitter, placed on a table about four feet square. The machines are compact and, of course, do not require an expert to operate them. They are essentially different in appearance and construction from the original machines, and the perfected instruments represent years of patient study and experiment on the part of Prof. Gray. A brief history of the several steps in the development of the telautograph is presented in the accompanying cuts, which illustrate the several types of machines produced in the experiments which led to the perfection of the present system. The first machine constructed, illustrated in Fig. 1, was completed in 1887. It was built on the variable resistance plan, but no provision was made for raising or lowering the pen or shifting the paper, these functions having to be performed by the receiving operator. On account of the numerous objections to any variable resistance system, this principle was abandoned and the step-by-step principle adopted. The second machine, shown in Fig 2, was completed in March, 1888. In this machine the step-by-step principle was employed. The sending and receiving apparatus were placed on one table, but each apparatus used its own roll of paper. In this instrument the pen arms were worked by means of "gripping armatures," which were operated by impulses sent from the transmitting end. This was an extremely complicated machine, the box under the leaf of the table being nearly filled with small pieces of electro-mechanism, but arrangements were made for moving the paper and raising the pen without the aid of an operator.

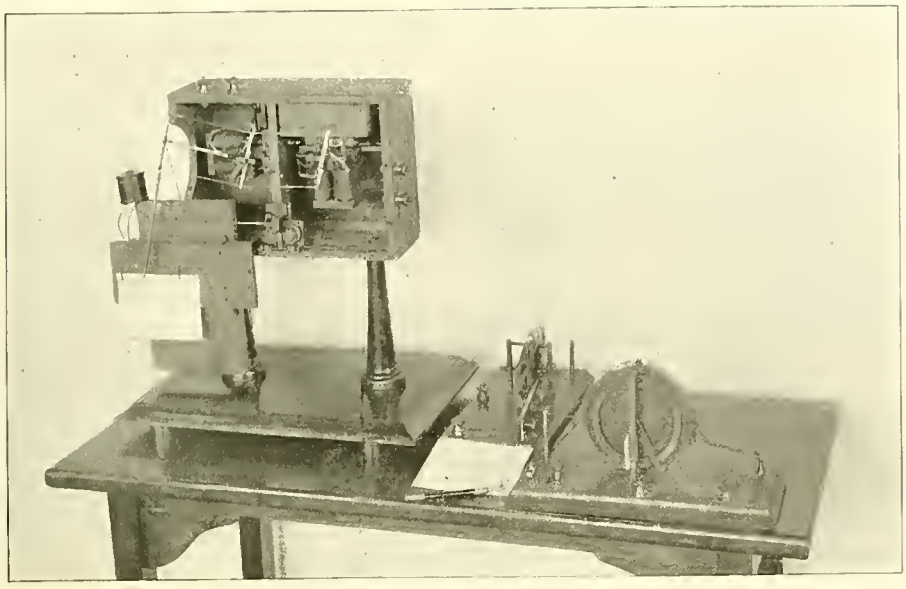


FIG. 1. ELISHA GRAY'S TELAUTOGRAPH.

Although this instrument was considered a great improvement over the original machine, Prof. Gray was not at all satisfied, and he continued his experiments, which resulted in reducing materially the complications of the old apparatus. The third machine, shown in Fig. 3, was completed in 1890. Here again the sending and receiving apparatus are combined on one table, and very satisfactory results were obtained, but owing to the delicacy of the parts and the crowding together of the mechanism the instrument was not considered good enough for commercial work, and further experimenting was commenced, which resulted in the production of the present instruments in 1892. These are shown in Figs. 4 and 5. In the last machines the transmitter and the receiver are separated and each is an instrument by itself. The transmitter has an ample arm rest to facilitate writing, shown in the foreground. The receiver is a very compact instrument. The pen arms are covered with glass and all of the working parts are under cover, so that there is small liability of their being affected by dirt or impaired from extraneous causes. By having the two instruments separated much greater simplicity is obtained; the parts are substantially built and the user has the advantage of having his own message on one blank and that of his correspondent on another, which facilitates filing. In sending a message an ordinary lead pencil is used, near the point of which two silk cords are fastened at right angles to each other. These cords connect with the instrument, and, following the motion of the pencil, regulate the current impulses which control the receiving pen at a distant station. This writing is done on ordinary paper, five inches wide, conveniently arranged on a roll attached to the machine. A lever at the left is moved by hand, shifting the paper forward mechanically at the transmitter and electrically at the receiver.

The receiving pen is a capillary glass tube placed at the junction of two aluminum arms. This glass pen is supplied with ink which flows, from a reservoir, through a small rubber tube placed in one of these arms. The electrical impulses, coming over the wire, move the pen of the receiver simultaneously with the movements of the pencil in the hand of the sender. As the pen passes over the paper, an ink tracing is left, which is always a fac-simile of the sender's motion, whether in the formation of letters, words, figures, signs or sketches.

An idea of the character of the work performed by this machine and the results obtained may be gained by an inspection of Figs. 6 and 7. These are photographic reproductions of work done on the machines which were exhibited last Tuesday, Fig. 6 being the message written by the operator on the transmitter and Fig. 7 the reproduction by the receiver. A close comparison of these two samples of writing will show that one is an exact fac-simile of the other, and were it not for the fact that the received work is done in ink and the sender's in pencil, one could scarcely tell them apart. This sample of work shows the capacity of the telautograph in transmitting writing, sketches and figures. Its transmission of short-hand notes, diagrams and general sketches is equally accurate except that the lines are not shaded.

On Tuesday it was announced that a line had been opened between Highland Park and Waukegan, a distance of 23 miles, and messages were transmitted without difficulty between these points.

The telautograph will be exhibited at the World's Fair by the Gray National Telautograph company. A factory has been erected at Highland Park, Ill., for the manufacture of the instruments. The upper floor will be used as a laboratory by Prof. Gray and his assistants. Prof. Gray has been assisted in all his telautograph experiments by the chief of his electrical corps, L. O McPherson, formerly electrician for the Postal Telegraph company. Mr. McPherson left the service of that company in the fall of 1886, and has devoted himself to the development of the telautograph ever since under Prof. Gray's direction. Foster Ritchie, who has been the chief mechanical expert for the last five years and is now superintendent of the factory, also deserves much credit for the mechanical excellence and finish of the instruments.

But the chief credit for the production of the telautograph, it is hardly necessary to say, belongs to Prof. Elisha Gray of Highland Park, Ill. Prof. Gray has devoted the greater part of his life to electrical experiments and has produced many valuable inventions. In the early days of telegraphy his inventions were chiefly improvements in apparatus in that line, his first patent, issued in 1867, being for a self-adjusting relay. His printing telegraph system was in use before the advent of the telephone; the harmonic telegraph was one of his great achievements, and his work in telephony has always been considered, by those familiar with the subject, of equal importance at least, with that of Prof. Bell. His caveat, dated February 14, 1876, contains the first written description of the speaking telephone. The first speech transmitted over a wire was with instruments similar to these described in that caveat, and so perfect is that description of the form of the telephonic current that nothing important has been added to it since. While the controversy over the telephone was in progress Prof. Gray took up the experiments, which ultimately resulted in the perfection of the telautograph, exhibited in Chicago and New York last Tuesday. He, like many others, questioned the adaptability of the telegraph and telephone to certain kinds of work. It was the impression of many of the leading men of the country that while the telegraph was valuable and the telephone a marvel that their adaptability to commercial work generally was out of the question. One authority said that the telephone would be a part of the laboratory apparatus in every college to show the marvels of electricity, but that business would never be done by a telegraph which makes no record. "Business will always be done in black and

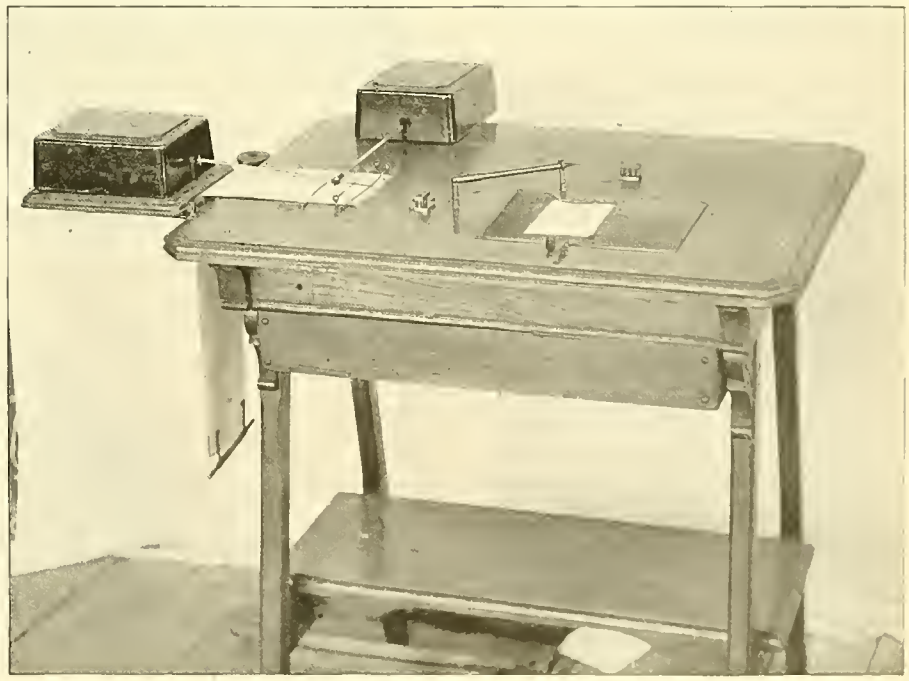
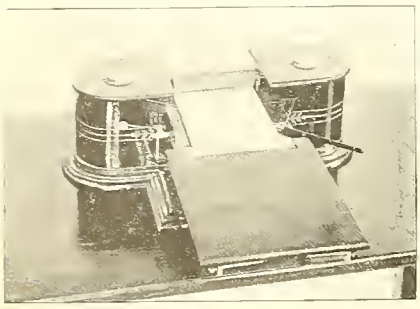
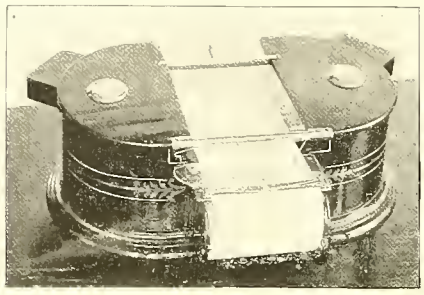


FIG. 2. ELISHA GRAY'S TELAUTOGRAPH.

white," was the general verdict. No doubt this prevailing opinion had much to do with suggesting the telautograph to Prof. Gray. At any rate he took the subject up and worked at it unceasingly until he perfected the idea.

Prof. Gray is now nearly 60 years of age, but he is well preserved, as will be seen from the accompanying portrait, which was made from a recent photograph. He was born at Barnesville, O., August 2, 1835, and was educated at Oberlin College. Prof. Gray is one of the best known of American scientists. He has traveled extensively in this country and abroad. At present his time is largely devoted to the preparations for the electrical congress which will meet in Chicago during the World's Fair. He is chairman of this department of the World's Columbian auxillary. At the Paris Exposition in 1878 Prof. Gray was honored with the red ribbon of the Legion d'Honneur. He has received other marks of destinction from scientific bodies. He is a member of the Chicago Electric club and the American Institute of Electrical Engineers.





FIGS. 4 AND 5. ELISHA GRAY'S TELAUTOGRAPH.

Production of Electricity.

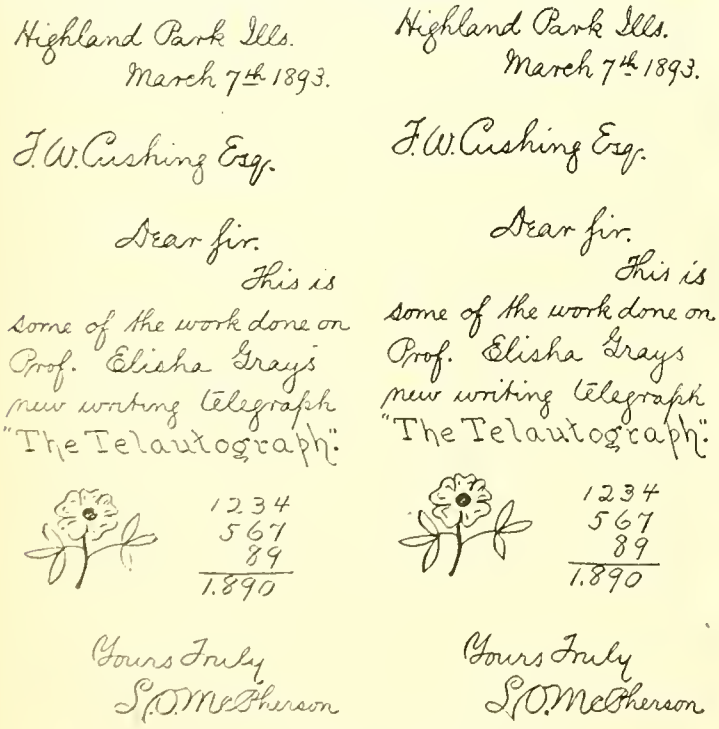
There are those engaged in trying to convert coal into electricity direct by shoveling it in at one end of an apparatus and drawing off electricity at the other end, says the *M[illegible] N[illegible]*. That scheme, however, with our present knowledge of electricity seems chimerical. It is doubtful if electricity can be economically produced by combustion chemical or otherwise, nor is there any need of producing it by any method. Electricity, as now used for power and light, is neither produced or created, but is simply collected by mechanical appliances, impelled by energy, the result of combustion, or by water power. Nature furnishes the supply, we simply collect and use it. Inasmuch as nature's supply is inexhaustable, why cannot a means for collecting it without the expenditure of energy be discovered? That is a question that ought to interest every electrician now in the field of discovery.

The Edison works at Schenectady, N. Y., were damaged considerably by a flood in the Mohawk river last week. The first reports of the loss were greatly exaggerated, however, although the damage was considerable. The total will not foot up $75,000. The machinery already prepared for the World's Fair is not seriously damaged, inasmuch as the largest pieces have already been shipped, and the smaller art [illegible] are located in the upper floors.

Closed Conduit in Street Railway Work.

On March 6th Frank C. Perkins read a paper before the Buffalo Electrical society on "Will the Closed Conduit Supersede the Trolley in Large Cities?" Mr. Perkins said: "It would be folly for any one to assert that the trolley system for operating electric railways will be thrown out of use in small cities, villages and rural districts; and until some efficient, practical and reliable closed conduit system is brought before the public, the trolley will still continue to be used in the large cities as well. A conduit system, however simple, could not compete with the trolley in the country, where long lines are necessary, and where wooden poles and a comparatively cheap line construction give good satisfaction to the railway company and is not seriously objected to by the public."

In large cities, he thought, where opposition is raised to the trolley on account of the so-called "unsightly overhead wires," the conduit system, when perfected, would find many advocates, and would be readily adopted by street railway companies. Regarding the cost of construction, he believed that a conduit system would compare favorably with the trolley in cities where the authorities insisted on the feeder wires being placed underground, and where an expensive line construction with iron poles, guard wires, etc., was required.



FIGS. 6 AND 7. ELISHA GRAY'S TELAUTOGRAPH.

Mr. Perkins referred to the Siemens & Halske system in Buda Pesth, and the Love and Bentley-Knight systems in this country as typical of the open slot conduits, which have given most promise in street railway work. Of these systems, generally speaking, he said: "The greatest difficulty the companies using the open-slot conduits have to contend with is maintaining a good insulation for the main conductors, the loss of current through leakage in wet weather being sometimes very great."

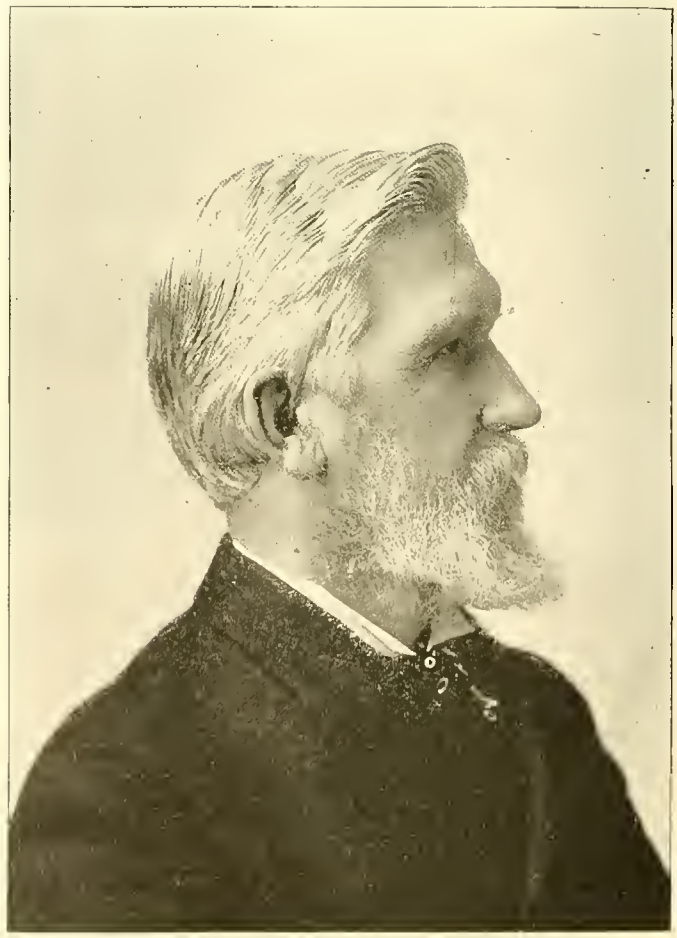
Brief reference was made to the closed conduit systems already devised, which were grouped under these headings: First, those operated electrically, such as the Lineff, Smith, Harding, Heron, Dewey and others; second, those operated mechanically, inclosing the Vandepolle, Thompson, Brain and others. Mr. Perkins has recently perfected a closed conduit system for street railways which contains some valuable features. In the course of his address Mr. Perkins briefly outlined the principal features of his system as well as those already mentioned.

Boston and Montana Electrolytic Plant.

H. R. Caulfield, superintendent of the New England Electrolytic Copper company at Ceotral Falls, R. I., has just completed and started successfully the large electrolytic plant for the Boston & Montana Consolidated Copper & Silver Mining company at Great Falls, Mont. The plant is certainly the largest and most complete of its kind on the American continent. The main building, which covers 300 by 525 feet of ground, is built of brick in a substantial manner, and contains 288 tanks or depositing vats, which are filled with 1,600,000 pounds of pig copper in the shape of anodes. This plant will turn out 1,200,000 pounds per month of electrolytic copper in almost a chemically pure state, all ready for wire or other electrical purposes.

The current used for the plant is generated by two Thomson Houston multipolar dynamos of 165 kilowatt capacity, and is transmitted a distance of 2,100 feet through twenty one half-inch copper wires. The total weight of the copper connections used for putting up this plant is over 55,000 pounds, and to line the vats and fit up for conveying the solution over 650,000 pounds of lead were used. The total cost of the plant, aside from real estate, was in the neighborhood of $350,000.

Heretofore, the Boston & Montana company, along with other copper producers, has been shipping the product of the mines to Swansea, England, in the shape of "matte" running about 50 per cent. copper, and by so doing losing all of the silver contained therein, but now since it has the electrolytic process for treating the material, every pound of ore will be treated at the works, thereby saving for its own coffers the silver and gold. At the same time, instead of shipping 50 per cent. raw material and paying freight on 50 per cent. waste to the East, it is enabled to ship the pure finished copper. This new process is gaining a strong foothold in this country. The Great Falls plant is the third large installation of this kind Mr.



PROF. ELISHA GRAY.

Caulfield has made, and all are now running successfully.

Patton Motor For Steam Railroad Work.

The Patton Motor company of Chicago is making arrangements for building a large machine which will be used on steam railroads. It is said that the first trip which this motor will be called upon to make will be between Chicago and New York, and that it will draw George M. Pullman's private car. The motor will have a capacity of 500 horse power and that it is expected, will be capable of attaining a speed of 60 to 80 miles an hour. The company has ordered a dynamo for this motor car of the Rockford, Ill., Electric company. It is expected that the equipment will be completed early in September.

Special Socket.

The accompanying illustration shows a keyless socket designed for theater work, for test boards in schools and colleges and for temporary illumination. The sockets are made either in wood or porcelain. The socket is manufactured by the Bryant Electric company.

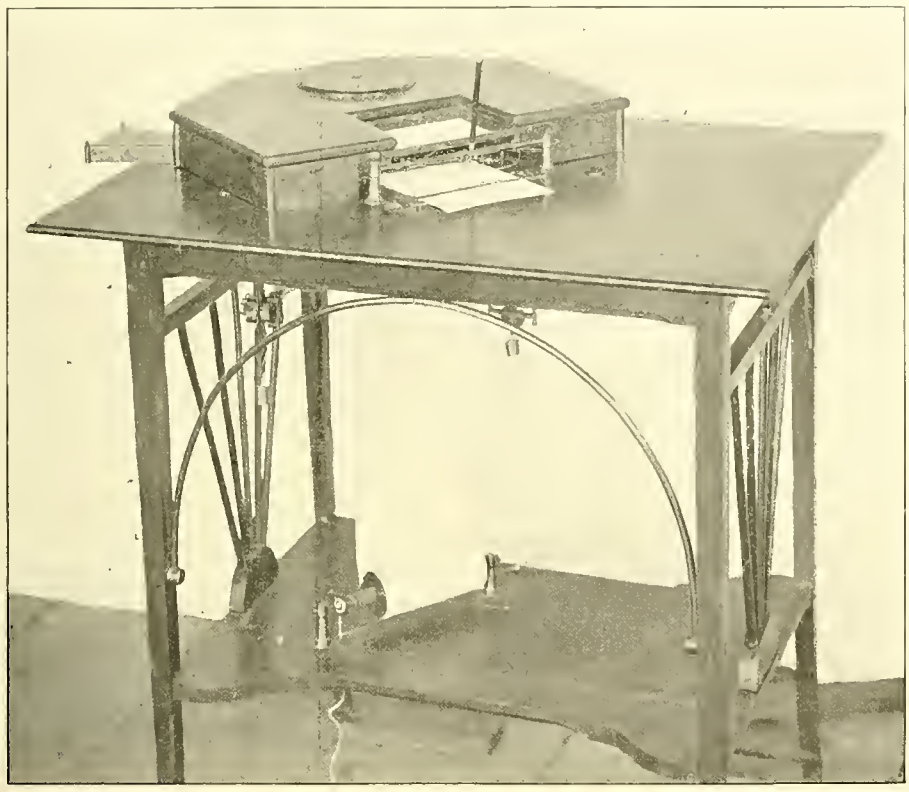
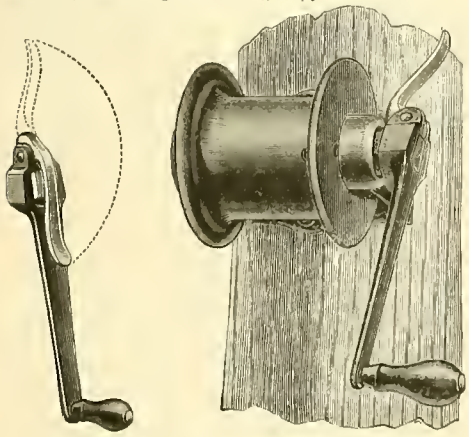


FIG. 3. ELISHA GRAY'S TELAUTOGRAPH.

Eddy Self-Locking Windlass.

The accompanying illustrations present a new arc lamp windlass, which embodies a number of desirable features. The drum of the windlass is substantially made of malleable iron, with a large and strong support for attachment to the pole, especial care being taken that the holes for the lag screws are far enough above and below the drum to allow their being driven and screwed home without having to remove the drum. The special feature of the windlass, however, is the way in which the crank answers the additional purpose of a key to lock or unlock the windlass. Fig. 1 shows the device unlocked, while Fig. 2 shows it locked. Lying in a groove in the shaft of the drum is a strong lever pivoted near its center, and having a powerful spring to hold it in the "locked" position. Inside the head of the drum, at the end opposite the crank, are six recesses, in the casting into any one of which the lug on the end of the lever is forced, thus allowing six positions in one revolution where the windlass can be locked. Simply placing the crank on the shaft has no effect on the locking mechanism, but after the crank has been set in place the lock can be released by forcing up the small tongue or hand lever shown in the cut. This forces a blade down upon one end of the interior locking lever, withdrawing the cam and leaving the windlass free to be raised or lowered at will. By simply pulling down the small tongue the windlass is again locked at any desired point. The lock is so made that it cannot be affected by any amount of rain or sleet. A great saving in time is accomplished. The windlass cannot be left unlocked, and cannot be opened except with the special crank made for that purpose. The windlass consists of practically three castings, which are made sufficiently strong and heavy to guard against breakage. There are no small or intricate parts whatever in the device. The Electric Appliance company of Chicago has the general western agency for this specialty.

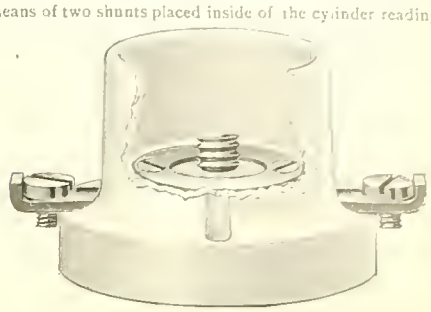


FIGS. 1 AND 2. EDDY SELF-ACTING WINDLASS.

New Measuring Apparatus.

In the accompanying cuts are illustrated some new measuring instruments, containing several important features.

Fig. 1 represents a new form of cylinder bridge, consisting of a revolving cylinder of polished hard rubber, 4 inches in diameter and 7 inches long, mounted on a frame. On this cylinder is cut a screw thread in which the wire is wound in 50 turns. In front of the cylinder and running its entire length is a wheel, having its platinized surface turned true so as to bear against the wire in a firm tangential contact. As the cylinder is revolved, the wheel slides along the scale, always in contact with the wire. This scale is divided into 50 parts, indicating complete turns. A wheel at the end of the cylinder is divided into 100 parts, each part being easily divided by the eye into tenths. Thus it is possible to read down to $\frac{1}{5000}$ part of the wire, or to the same fraction of an ohm. By means of two shunts placed inside of the cylinder readings as low as .000002 ohm can be made. This makes the bridge very useful in determining temperature coefficients. The advantages of this arrangement are that readings are more easily made, the form is such that the wire cannot pull out of the end junctions, the contact is rolling and does not indent the wire and the ends of the wire are near together, so that they are practically of the same temperature.



SPECIAL SOCKET.

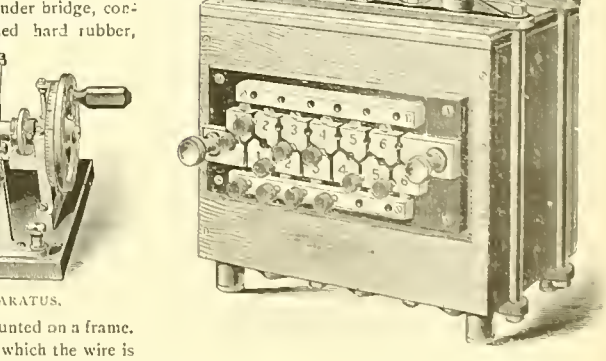


FIG. 1. NEW MEASURING APPARATUS.

Fig. 2 represents a special form of commutator for use in comparing resistances and finding temperature coefficients by the Carey-Foster method. The instrument consists of an arrangement of thick copper connectors, placed on an insulating base and arranged in perfect symmetry with respect to its longer axis. The terminals for the unknown and standard resistances are arranged so that two coils in multiple can be placed on either side, a very useful feature in determining the resistance of a unit length of bridge wire. The two coils R and $R2$, in the usual formula, are wound together on a spool and inclosed in a cylindrical brass case S having their resistances engraved on its top. The terminals of these coils are four copper rods bent so as to accommodate themselves to the same number of mercury cups T, mounted on a hard rubber platform P. This arrangement facilitates changing these coils when resistances of various dimensions are to be compared. In the center of the apparatus are two groups of four mercury cups, each arranged in the form of a square. These cups are connected by two sets of connectors CC, passing through two hard rubber platforms provided with little handles. By suitably turning these two platforms the positions of the unknown and standard coils can be changed, as can also the direction of the battery electromotive force making it act alternately with and against that of the thermal junction of the bridge wire and its copper

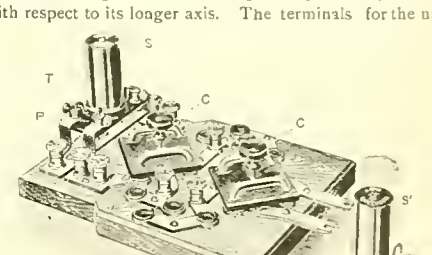


FIG. 2. NEW MEASURING APPARATUS.

FIG. 3. NEW MEASURING APPARATUS.

terminals, and thereby avoiding errors. The instrument is placed ready for use by connecting the straps B, across the gap of a meter bridge.

Fig. 3 is an adjustable rheostat for laboratory purposes, depending for action upon the fact that the resistance of carbon is decreased by compression. The carbon used is

in the form of rods placed flat, layer upon layer, in sections arranged for the purpose. A metal-faced pressure block, moving like a piston, in each section, and operated by a wheel above, makes a contact with the upper layer, while a metal sheet binds against the lower. Each section is constructed to carry from 0 to 25 amperes at an electromotive force not over 5 volts. The terminals of each section are brought to a switch-board, by means of which the sections can be connected as desired. Using the sections in multiple the rheostat may be made to carry 150 amperes. Currents up to 25 per cent. above these figures may be passed through for a short while. The regulation of the resistance, which is accomplished by means of the pressure blocks, is a special feature of the instrument. The resistance may be varied from 0 to 150 amperes to as close a degree of accuracy as may be detected by the current indicating instrument. The change, moreover, is gradual and not by steps as it must always be in the ordinary form of rheostat. It is therefore of especial value in calibration work and for determining the characteristic curves of dynamos and motors. The whole instrument is substantially put together and can be readily carried from place to place. It is placed on the market by Queen & Co., Philadelphia.

Charged with Forgery.

The Southern Engineering company of Louisville, Ky., has issued a circular letter in relation to a man giving the name of C. P. Hayes, with whom it seems to have had an unfortunate experience. These statements are made by the company:

We have issued a warrant for the arrest of one "C. P. Hayes," on the charge of forgery and obtaining money under false pretenses. This man was employed by us for several weeks as electric wireman and for two weeks previous to March 14th, was employed as a local solicitor. On the night of the 14th instant he left town after defrauding a considerable number of our customers and ourselves. We are more than desirous of affecting his arrest and to prosecute him to the full extent of the law. Since his flight from this city we have ascertained that he is a celebrated crook and has before probably, defrauded other electric companies and we earnestly request that you lend us your assistance in bringing this rascal to justice. We fear that unless we take steps to punish him as he deserves he will continue swindling other electric companies and we ask this for your protection as well as ours. He is a fairly good wireman and an excellent talker and will most likely apply for a position as wireman or salesman. Kindly watch out for this man and immediately notify us by wire in case a man answering this description should apply to you.

The description of the man is as follows:

Height about 5 feet, 11 inches; weight, about 160 pounds; well built, broad shoulders, slightly inclined to stoop; hair, long and curly and of a reddish brown color; eyes, dark blue, with very large eye-balls, with a great deal of white in them; mustache, reddish in color and very long and drooping; complexion, reddish but clear; nose, straight and aquiline. In walking takes long, quick steps, with shoulders thrown forward. Talks unusually rapidly and ends his sentences abruptly, and in conversation raises his eyelids with a knowing stare. Uses excellent language and choice of words and is what one would term a very "smooth" talker, and is calculated to make an excellent impression. Teeth are sound, regular and white. When last seen wore a black derby hat, black single breasted overcoat, black diagonal vest and cutaway coat, and dark striped trousers.

A Question of Wages.

To the Editor of the WESTERN ELECTRICIAN:

Every person in any way connected with the electrical industry must be interested in promoting it to the highest place possible. Though the science is but partially understood, even by our best thinkers, yet it is generally conceded that this subtle power is to be the principal agent of the future in subduing the universe to the service of man. All desire to obtain these ends—the question is, how?

To those outside the business the question is, how shall we have light, power, etc., without an increase in fire insurance rates? To practically apply the theories evolved by our electricians requires the services of our best engineers and most skillful mechanics. In order to secure these, wages must be paid which correspond favorably to those paid to mechanics in other branches of trade. What inducement is there for a good mechanic to enter or remain at the trade when others requiring less skill offer him 50 per cent. more money? Is it cheaper to hire two inferior men to do a poor job, or one good men to do the same work in a workman-like manner and pay him well for it?

A few years ago stations were usually put in the back end of a sawmill or the basement of a livery barn. It did not pay. Now buildings are designed especially for the purpose by the best engineer and the most improved machinery is used with small regard to cost. This is a big stride forward, and the business of to-day is a credit to the far sighted men who instituted the new order of things. The policy of having only the best will pay in all departments in the long run. Prepare your dynamo men to be expert, your wiremen and linemen to be good machanics and all employes to be sober and industrious and do a fair day's work. If there is not enough men of this class in the business now, this policy will soon bring them. Water seeks its level; to a good trade good machanics will come. To a poorly paid trade good mechanics will not come. And the greatest of modern industries will be murdered by incompetent workmen.

It has been too much the habit to consider that anybody is good enough to do electrical work. If a man puts up a house he calculates the plumbing as one of the most important parts, the wiring as a side issue. But if he paid for this in the same proportion as other things he would appreciate it more. Being installed in the best manner it gives him good service and being absolutely free from fire risks he gets in time a lower rate of insurance. The electric and insurance companies will shake hands and a new period of increased prosperity will then open to the electrical industry. Remember that in this as in all other things "the best is always the cheapest." PAUL PIERCE.

Chicago, March 13, 1893.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 18.—With a solitary exception the daily papers of this city practically condemn the so-called rapid transit scheme of the commissioners, and there is no doubt that they voice the sentiment of the people in this matter. They are all greatly disappointed, and many are deeply disgusted with the report of the commission. The *Times* concludes an editorial on this subject with the following paragraph:

Meanwhile, what are the weary people going to do about rapid transit? Do they care for it? Do they still foolishly hope for it from the present commission? Will they make any other and independent effort to secure it? Thus far they have been fooled and swindled. That ought not to continue.

The *Herald* condemns the plan in unmeasured terms, and pronounces it absurd and preposterous. It says:

The result reached by the Rapid Transit commissioners must be a grievous disappointment to every citizen who has looked to these officials to give New York some sort of rapid transit at once. It is simply a dismal failure.

The chief feature is simply the addition of a third track to the elevated roads, and not even a third track is provided for on the line where it would be most useful—namely, Sixth avenue. This would admit of "express trains" only in one direction at a time, and they would not be the fast trains that the people want and have a right to expect.

But the most disappointing aspect of the failure is that no provision is made for any new line or any extension of the elevated system that amounts to anything. No new region is reached or new territory opened up.

There are two plain courses now open to these commissioners, and only two. One is to go ahead and give New York rapid transit at once. The other is to resign and let this pressing public duty be undertaken by others.

At the regular meeting on Sunday of the Structural Iron Setters' Protective and Benevolent Union resolutions were adopted protesting against the charges made by the Bell Telephone company for the use of its telephones. The union will petition the government to revoke or abolish the patent on the ground that "the inventor is not receiving the benefit of its use, and the monopoly controlling it has grown rich by its use." W. F. O.

Milwaukee, Wis.

MILWAUKEE, March 18.—Henry C. Payne, the local representative of the Villard syndicate, is very much discouraged at the outlook for the extensions of the Milwaukee street car system during the present year. The adverse legislation which is threatened, he says, has already seriously hampered the company in the money market. Mr. Payne says that the bills introduced in the state Legislature to place a tax of 6 per cent. on the earnings of the road and the ordinance pending in the Common Council to place another tax of 2 per cent. on the same earnings, together with the persistent efforts to pass a time schedule with which it will be impossible for the company to comply, have effectually frightened capital. The company is developing its system, and has already spent several millions in the work. In the ordinary course of things, Mr. Payne says, it would take a life-time of the most excellent business for the company to get out the money that has already been invested. He declares that the idea of an 8 per cent. tax is preposterous and that the way the company is being hampered is outrageous. He intimates that the extensions to Cudahy, to Lyon park, to the East Side park and to the Polish settlement on First avenue, and other branches and spurs, will have to be abandoned for the present, although it had been intended to build them during the current year.

On April 1st the West Side street railway, or Becker system, will be formally transferred to the Villard management. The contract of sale provides for three payments, two of which have already been made. The third and last payment will fall due on the first of the month and then the Villard company will be in possession of all the street car lines in the city except the Hinsey road, and it will not be long before that, too, is a Villard property. No material change in the management of the Becker line is contemplated at present. New rolling stock will be added as fast as the cars can be procured.

A week ago electric cars began running on the Washington, Eighth and State street line. The cars start at the exposition building and run to the southern terminus. On the north part of the line horse cars will continue to be in operation for a few weeks. The line is the longest one in the city and it extends from Forest Home cemetery to Union cemetery. It is the only track in the city on which horse cars are seen.

The new cars which are now being received by the Villard company are light in color, with yellow trimmings. Their total length is 22 feet, four feet longer than any cars that have yet been used in Milwaukee. They are of the accelerator pattern. The cars are being made by the Brownell company of St. Louis, and at Pullman.

The new cars continue to arrive quite regularly and more than a hundred are now in service. The time for furnishing a hundred summer cars expires April 1st. The company, by reason of the erection of a temporary power plant, now has power for running two hundred cars, while it is estimated that it will not have to furnish power from the River street and temporary plants for more than 120 cars. During the last few weeks the company has had to have an unusually large number of motors in reserve, the water on the tracks damaging many of them.

From different parts of Wisconsin and Northern Michigan come reports of the organization of new telephone companies to compete with the Bell exchanges. The Eau Claire Telephone & Lighting company has been organized to introduce one of the new systems. At Racine the Wisconsin Automatic Telephone company has been formed with a capital of $500,000. It intends to use the Strowger automatic system. The company has secured a franchise to run lines in Racine. A. B. Ferdinand, the manager of the Wisconsin Telephone company at Racine, has resigned in order to accept a position with the new company. It is announced that at Marquette, Mich., arrangements have been perfected to put in a telephone exchange in opposition to the Michigan Bell Telephone company. The Harrison automatic switch system will be used and the exchange will furnish service to all of Northern Michigan.

W. B. Roberts and George A. Mayo, of Rockford, Ill., have been in the city for several days with a view of securing a site for a plant in Milwaukee. The plans show a main building, 150 by 300 feet, three stories high, and several other buildings. The company employs 150 hands. It is willing to locate in Milwaukee if $50,000 of the stock is placed here.

The H. A. Doty Power & Light company at Janesville, Wis., will shortly erect a new power house.

The Appleton Edison Electric company will build a new stone power house on the government canal in that city. The old building will be used as a tool and store house. Several additional dynamos will be put in by the company.

The scheme of extending Appleton's electric street railway to Menasha is being vigorously pushed. Surveys have been completed and bills are pending in the Legislature for the construction of two bridges across the Fox river.

The South Milwaukee Light & Power company has filed articles. The incorporators are Frank H. Brice, William M. Williams and A. W. Bell. The object is to furnish electric light and power in South Milwaukee. The capital stock is $15,000.

Sinclair Mainland, the proprietor of an excelsior factory at Oshkosh, was nearly killed by an electric shock a few days ago. While lighting a gas jet in Odd Fellows Hall, he by accident grasped with one hand a live electric light wire and he fell to the floor unconscious.

The Oshkosh electric light contracts have expired and that city is considering the matter of establishing a municipal lighting system. The city has been paying $12,000 for its electric lights. The cost of a city plant is estimated at $50,000. C.

Northwestern Notations.

MINNEAPOLIS, March 18. The St. Paul authorities are still wrestling with the problem of how to get the wires underground without seriously embarrassing the companies. The assembly committee has finally agreed upon an ordinance which it is hoped will solve the puzzle. Many concessions have been made at the urgent request of the companies affected. The programme now mapped out is as follows: All wires are to be beneath the surface January 1, 1897. During 1893, 2,000 feet of the streets is to be cleared, 4,000 during 1894, and 6,000 during 1895, the balance during 1896. The provisions requiring the payment of a 3 per cent. tax and the deposit of $500 are knocked out. So is that requiring the companies to repave the streets used by them. The requirement that the companies furnish space in their conduits for the city's wires is

eliminated. The proposed ordinance does not apply to the street railway company's wires, nor to those of the Edison or telephone companies. The rights granted under the ordinance are limited to 30 years.

Things look very dubious in St. Paul in the street railway controversy. The elaborate scheme for compromising all disputes submitted by President Lowry and endorsed by two committees and the press generally, was rejected at a joint council meeting by the decisive vote of 11 to 4. President Lowry repeated his statement that if the aldermen insisted on demanding unreasonable things of him he would be obliged to refuse to comply and would forfeit the franchise if necessary. The great bone of contention is transfers to the interurban line. Mr. Lowry absolutely refuses to consider any proposition that does not include the abolition of the transfers, the same as the Minneapolis council has granted. The aldermen have acted in the face of a strong public sentiment in favor of accepting the compromise.

There is some talk of another attempt at compromise, and one of the aldermen has drawn up a measure which provides for the changing of the East Seventh street line to an electric line, a double track line to Como park, the operation of the Maria avenue and White Bear lines to and around the loop, the extension of the Selby avenue line to connect with the interurban at Prior avenue, and the provision of a safety attachment to secure absolute safety on the Selby avenue and other hills.

Thomas S. King, the man who organized the Brush Electric Light company of Minneapolis ten or twelve years ago, died at his home in Minneapolis recently. Mr. King was a pioneer citizen and newspaper man. He was famous as a fighter, especially with his pen, and while he was secretary and general manager of the company he made some brilliant speeches and wrote some remarkable communications in defense of what he believed to be the rights of the company. He retired from the management about five years ago. While he has been in poor health for many months, largely from the effects of a fall, the final sickness was of but a few days' duration.

The bill requiring companies operating street railways in Minnesota and using cars propelled by electricity to enclose the front platform during certain periods of he year has been reported favorably in the Legislature. The bill provides that during the months of January, February, March and December the front platforms must be so inclosed as to protect the motorman from unnecessary exposure. Fifty per cent. of such cars shall be so provided by December 1, 1893, and all cars shall be enclosed by December 1, 1894. President Lowry has expressed his willingness to comply with the requirements of such a bill.

A story has been afloat here of late to the effect that an Eastern syndicate was trying to secure the St. Paul street railway system. Mr. Lowry gently but firmly denied the rumor.

The Huron, S. D., council has accepted the proposition of the Huron Electric Light company to light the city pending the settlement of litigation.

The Cooper-Hampton Electric company will put one of its patent elevators in the Minneapolis exposition look-out tower next summer and run it as a part of its exhibit.

Dawson, Minn., is figuring on getting electric light. Owatonna, Minn., wants a telepone system. New Paynesville, Minn., is raising a $5,000 bonus for a light plant.

The city council of Fargo, N. D., has granted a franchise to a new electric company and a plant will soon be put in. The new company is not in any way connected with the Fargo Gas & Electric company.

At a meeting of the city council of Butte, Mont., a petition was received asking a franchise for the Montana Mutual Electric Light & Telephone company in which permission is asked to erect poles for electric and telephone service. The capital stock is $2,000,000. N. L. P.

PERSONAL.

George A. Mayo of the Rockford Electric company was in Chicago last Monday.

Henry L. Walker, secretary and treasurer of the Detroit Dynamo company, spent a few days in Chicago last week.

Frank S. DeRonde, general sales agent of the Standard Paint company, has been a visitor in the World's Fair city for the last week.

S. F. B. Morse of Cushing & Morse, Chicago, representatives of Day's Kerite, left for New York on Sunday last. Mr. Morse will be in the East for some time.

A. W. Meston, superintendent of the Emerson Electric Manufacturing company, St. Louis, has just left home for a month's trip to Florida, Jamaica and Cuba. Mr. Meston has not been in the best of health for some time, and his vacation is taken that he may have a much needed rest.

Frederick A. Scheffler, superintendent of the Brush Electric company, has tendered his resignation, to take effect April 1st. Mr. Scheffler has for several years been actively identified with the manufacture of electrical apparatus, and for a number of years previous was engaged in the production of steam engines and boilers. After April 1st Mr. Scheffler will go to Passaic, N. J., where he will be associated with E. K. Rose.

Nelson W. Perry, editor of the *Electrical World*, New York, will receive the sincere sympathy of his friends on the occasion of the death of his father, Aaron F. Perry, which occurred in Cincinnati on March 11th. The deceased was one of the leading members of the Cincinnati bar, and was held in high esteem by his fellow citizens. He was a native of Vermont, but the greater part of his professional career was spent in Cincinnati. He had been a member of the state Legislature, and in 1870 was elected to represent the First Ohio district in Congress.

NEW INCORPORATIONS.

Metropolitan Magneto Fire Alarm company, New York N. Y; capital stock, $250,000; manufacture of electrical apparatus.

The Direct-acting Electric Gong company, New York, N. Y.; capital stock, $15,000; the manufacture and sale of electrical and mechanical apparatus.

Kimball Electric company, Chicago, Ill.; capital stock, $5,000,000; to construct street and other railways; Allen & Payne, 517 Unity building, Chicago, Ill.

Star Electric Lamp company, Chicago, Ill.; capital stock, $25,000; to manufacture and sell electric lamps; Francis W. Parker, 1007 Opera House block, Chicago, Ill.

Muscatine Electric Railway company, Oakaloosa, Iowa; capital stock, $300 000; to purchase and operate railway, light and power plants; Seevers & Seevers, Oakaloosa, Iowa.

Electrical Conduit Traction Equipment company, Newark, N. J.; capital stock, $200,000; to make, manufacture, purchase, sell and deal in electrical appliances, etc.; Percy Jackson, 2 Wall street, New York, N. Y.

Globe Storage Battery company, Chicago, Ill.; capital stock, $1,000,000; manufacture, work and sell electric storage batteries, apparatus, machines, etc; H. Buerdorf, 820 Home Insurance Building, Chicago, Ill.

Davis Electrical Works company, Saco, Maine; capital stock, $200 000; to produce, supply and repair incandescent lamps and to manufacture, deal in and use electrical apparatus; Bairfield & Moore, Saco, Maine.

National Light & Construction company, New York, N. Y.; capital stock, $200,000; buying and selling gas and other patents, also manufacturing gas and electricity; Geo. W. Clark, 181 Broadway, New York, N. Y.

West Side Traction company, Philadelphia, Pa.; capital stock, $10,000; construction and operation of motors and cables or other machinery for supplying motor power to pass railways; John C. Bell, 333 Walnut street, Philadelphia, Pa.

Montana Mutual Electric & Telephone company, Butte, Mont.; capital stock, $400,000; erecting, maintaining and operating electric railways, and the manufacturing and selling of electrical mining and all other machinery.

International Trading & Electric company, Bayonne, N. J.; capital stock, $25,000; to do a general trading and export business, buying and selling merchandise, acting as consulting and contracting engineers for equipment and installation of electrical and mechanical plants, etc.; Chas. Angus, Times building, New York, N. Y.

Chicago, Niles & Norwood Rapid Transit company, Chicago, Ill.; capital stock, $500,000; to secure right of way for and construct and operate single or double track electric street railway on public streets or highways from a point in the limits of Chicago, Ill., thence northwesterly to point near west line of the township of Niles, thence southerly and southeasterly to another point within the limits of Chicago, and furnish heat, light and power along line of same road; F. A. Bingham, 707 Opera House Building, Chicago, Ill.

ELECTRIC LIGHTING.

The Norwalk, O, Incandescent Light & Power company has made an assignment. The liabilities are estimated at about $35,000, with assets of $35,000 to $40,000.

The Dundee, Ill., Rapid Transit company has been incorporated, and the present electric light plant is to be enlarged to furnish the power for an electric road to be built to Carpentersville.

The Cleveland General Electric company will soon break ground for the erection of a large central station on Canal street. The company recently purchased 230 feet of land at a cost of $23,700. Plans for the power house are now being prepared. It will be a handsome structure, and when completed will have a capacity of 10,000 horse power.

The Electric Improvement company of San Francisco, which recently sold out its central station plant in that city to the Edison Electric Light company, has purchased all the rights for the Pacific coast that the California Electric Light company had in the Brush patents. The old California Electric Light company had a contract with the Brush company that gave it absolute control of the Brush rights on the Pacific coast. This contract has now passed to the Electric Improvement company, and all Brush apparatus will now be sold by the latter company. The Improvement company also has the Pacific coast agency for the Fort Wayne Electric company, and it proposes to push business on the coast.

ELECTRIC RAILWAYS.

Two companies are fighting for the franchise to build an electric railway through Rahway, N. J. One company proposes to run to Carteret, the other to Woodbridge and Boynton Beach. The projector of the latter company is the owner of an electric light plant in Rahway. A special meeting of the city council will be held March 16th to consider the propositions of the two companies.

The construction by New York capitalists of the proposed electric railroad from Manchester, near Richmond, Va., to Petersburg will furnish a line which will compete with the Atlantic coast line. This competition, however, will only apply to the local freight and passenger traffic. The road, which will be about twenty-four miles long, will cost about $300,000 to construct. It may, and possibly will be connected with the system of electric street railways of Richmond and Manchester.

TELEGRAPH.

A dispatch from Albany of March 17th says: The Municipal Telegraph company was incorporated with a capital of $100,000. The general route and the points to be connected, by telegraph lines to be constructed, are as follows: From Albany to New York, there to connect with the principal places in Westchester and Kings counties, to the cities and towns of Erie and Saratoga counties, and other cities and towns in New York state. Beyond the limits of this state the line will be operated from Albany to the principal cities and towns in New Jersey, to Chicago, to Louisville, Lexington and Covington, Ky.; to Nashville and Memphis, Tenn.; to New Orleans, to St. Louis, Baltimore, Washington and Montreal. The directors are John Mack, James L. Holland, William Lane, John Graham, Patrick H. Mack of Albany, John S. Campbell of New York city and James H. Ryan of Troy.

At the last quarterly meeting of the Western Union directors, the quarterly dividend of one and one-quarter per cent. was declared, payable on April 17th to stockholders of record at the close of the transfer books on March 20th. The conditions of the company, at the close of the quarter ending December 31, 1892, was reported as follows: Surplus October 1, 1892, $14,476,155.69, of which there has since been capitalized, by the issue of additional capital stock distributed to stockholders December 3, 1892, $8,618,509.94; net revenue, $2,612,918.42. Deducting for dividend of 1¼ per cent. paid January 16, interest on bonded debt and sinking funds, leaves a surplus January 1, 1893, of $6,442,693.17. The net revenue of the quarter ending March 31, based upon nearly complete returns for January, partial returns for February and estimating the business for March, will be about $1,675,000. The present surplus, after paying dividend, is $6,689,818.17.

MISCELLANEOUS.

A press dispatch from Yuma, A. T., says: The new electric steamer built by Stacy Brothers was successfully launched. She will be used in the ore and mining trade between Yuma and the mines on the Colorado river. She is the largest boat ever built to be propelled by electricity. She will carry fifty tons on twenty inches of water.

The bill before the Illinois Legislature taxing the gross receipts of telegraph, telephone, express and insurance companies 3 per cent., which was origioally reported to the house by the committee on corporations and subsequently recommitted to the Committee on Judiciary on second reading, came up last week. There was no attempt to report the bill but it was referred to a sub-committee, the general opinion being that it was clearly unconstitutional.

Several members of the Massachusetts Legislature were in Chicago recently in search of information about rapid transit and the burial of electric wires in cities for application in Boston. The visitors gave a banquet to Chicago city officials at the Auditorium. Among the speakers was Prof. John P. Barrett, city electrician of Chicago. In his remarks he made a recommendation which was accorded the greatest attention and which is of interest to many cities that, like Boston, are seeking rapid transit. It was to wait until the lesson that the World's Fair had to teach in this respect had been studied.

An explosion which broke hundreds of windows and frightened many people occured in the conduit on Market street, Pittsburg, last week. The conduit is to be used in the underground system of wires for the Central District & Printing Telegraph company. The concussion was so great that the shock was felt plainly all over the down-town district, and people ran in all directions. Goods put up in glass in some of the stores were broken, and similar damage was done to glassware and china in dwellings and saloons. The gas which did the damage is thought to have been either illuminating or natural gas, because there is no sewer near the conduit at that particular point.

Delegates to the recent St. Louis convention were entertained in a great many ways during their stay, but one of the most enjoyable as well as novel parties was that given by W. H. Thomson of the Boatmen's Bank, and Mr. and Mrs. T. M. Ambler in honor of Judge Armstrong of Camden, N. J., the newly elected president of the National Electric Light association and a party of eastern visitors. The party was accompanied from the Southern Hotel by Capt. and Mrs. McCullough, Mr. and Mrs. J. A. J. Schultz and Mr. and Mrs. Siegrist to the Boatmen's Bank building, which was beautifully illuminated in honor of the occasion. After being shown through the vaults, offices, etc., the guests were taken to the basement, where an "informal lunch" was served. The visitors conceded that St. Louis owned one of the most complete banking establishments in the world. The Grand Opera House was then visited to witness the performance of "Cleopatra."

TRADE NEWS.

The Norwich Insulated Wire company of New York is presenting to many of its friends a photograph of its exhibit at the recent St. Louis convention, which was gotten up in a very artistic manner.

Henry B. Cutter, president and general manager of the Cutter Electrical & Manufacturing company, Philadelphia, passed several days in Chicago recently introducing his new C S. flush switch, which is being favorably received.

The Russell automatic switch has made a place for itself. To control electric lights from the bedroom, the hall, the porch, or from any place about the house, has long been desired. The Russell automatic switch does this. Like all good inventions it deserves the success attending its introduction. Edward R. Grill of Chicago sells them.

The new and palatial private car of President McLeod, of the Philadelphia & Reading railroad, built by the Pullman company, is equipped with the Johnson switches, manufactured by the Interior Conduit & Insulation company. The Central Electric company, Chicago, has the western agency for these switches. The car was also wired throughout with Okonite wire.

The Law Battery company of New York is sending out a very handsome catalogue and price-list combined in pamphlet form, illustrating and describing the company's apparatus. It is one of the most valuable catalogues regarding batteries that has been issued. This company recently received a large order for its batteries from Shippey Bros., London, Eng.

A recent catalogue issued by the Weston Electrical Instrument company of Newark, N. J., leaves little to be learned about the construction and operation of standard voltmeters and ammeters. The Weston instruments have a wide reputation, and the electrical man who desires detailed information regarding them should send for this new catalogue. Chas. D. Shain, 136 Liberty street, New York, is the popular selling agent.

The Phoenix Iron Works company of Meadville, Pa., reports among the sales of Dick & Church tandem compound engines for March the following: Carnegie Steel company, Pittsburg, Pa., two condensing engines of 150 horse power each; Gokey & Sons, Jamestown, N. Y., two non-condensing engines of 150 horse power each; Trumbull Electric Railway company, Warren, O., one non-condensing engine of 150 horse power; Salt Lake City Electric Light company, one non-condensing engine of 115 horse power.

The Chicago City Railway company is pushing its construction of cross-town lines vigorously. These will all be operated electrically and will be completed in time for World's Fair traffic. There will be over one hundred and twenty miles of cross-town electric roads. The Ansonia Electric company (formerly the Electrical Supply company) of Chicago has secured the contract for the overhead equipment of these lines. The business of the Ansonia Electric company is not confined to the sale of street railway supplies, but it has a distinctive railway supply department fully alive to all requirements, and having several large factories in Ansonia, Conn., it can manufacture a superior line of supplies after its own models and fill orders expeditiously and satisfactorily.

The Mica Insulator company, 218 Water street, New York, is getting out some special grades of micanite. Three grades of micanite plates are now being put on the market. Grade one is especially made for commutator segments, strips and rings, and armature cylinders, shafts and cores. Grade two can be used where exact thickness is not essential, and grade three is suitable for rings, washers and disks, and for insulating armature cores, field magnet cores, etc. The company also announces that it is prepared to supply commutator segments, cut to any pattern and thickness, taper rings for motors, tubes in all sizes, armature troughs of all dimensions, armature rings of any size and thickness, micanite cloth for new work or repairs, and micanite paiot for armature and field coils.

The Patton motor for street railway service has been in operation on the Louisville, Ky., street railway lines for some time and has proved very satisfactory. The Patton company has just received an order for 17 additional equipments from Louisville. Several changes have been made in the motor during the last year. Following is a description of the improved type. The motor consists of a gas engine, 25 to 28 horse power; a shunt wound dynamo of 250 volts and 60 to 80 amperes, a 220 volt, 35 horse power electric motor on the axle and a 220 volt storage battery. When the dynamo is started, from thirty to thirty-five amperes are put in the battery. The dynamo and batteries are in series with each other and in multiple to the motor, and when the motor is cut in the current leaves the battery and goes to the motor. Now if the output of the dynamo is not sufficient to drive the motor up to its speed, the voltage of the dynamo will drop to that of the battery on account of overload, which will allow the battery current to come out in multiple with the dynamo current to the motor. Immediately after passing a grade or curve, the engine "speeds up" and the voltage rises, thus cutting out the battery requiring no automatic switch or device of any description. The company depends solely upon pressure for regulation. About the only change of importance in the construction of the present machines from the one last built is the placing of the dynamo on the engine shaft in place of one of the fly wheels, thus doing away with the friction pulley and the accompanying noise and the room taken up with the dynamo, and making an engine of somewhat higher efficiency, fewer parts and less weight.

BUSINESS.

Among recent orders received by the Ball Engine company of Erie, Pa., was one from the Case Alameda Hotel, New York, for two 80 horse power engines and one of 200 horse power capacity from the Tampa, Fla., Street Railway & Power company.

Attention is called to the fine exhibit of Lundell motors by the Central Electric company, Chicago, consisting of a motor driving a dynamo, which in turn generates current to operate lamps, fan motors or the new Lundell exhaust outfit. High efficiency is shown in this combination.

The General Incandescent Arc Light company of New York has just established a Chicago branch at 173-175 Adams street. L E. Frorup will be the company's western representative. Mr Frorup is an experienced salesman, having been with Bergmann of New York for a long time and also with the western branch of the old Edison company under John I. Beggs. Under Mr. Frorup's energetic management the General Incandescent Arc Light company will undoubtedly do a thriving business in the World's Fair city and the adjoining territory.

Albert Fisher, of the Watertown Steam Engine company, Watertown, N. Y., is pushing his engine most energetically in the West. Mr. Fisher will be remembered as general western manager for the Ball Engine company, but since January he has been connected with the Watertown company. Mr. Fisher is continuing his good record as an engine salesman. One of his recent sales that is particularly worthy of mention is that of a 140 horse power Watertown engine and two 80 horse power boilers to the Muncie, Ind., Light, Heat & Power company. Mr. Fisher is an aggressive man and without doubt will do a good business for his concern in the West.

H. H. Cutler and E. W. Hammer, under the firm name of Cutler & Hammer, have recently started an enterprise in Chicago. Messrs. Cutler & Hammer have purchased George Cutter's factory, 313 South Canal street, Chicago, and have started in a special line of electrical construction work. Architects, electrical engineers and inventors realize the need of a concern that can be relied upon to give expert attention not only to the designing of electrical apparatus but to the development of it from preliminary sketches. This new firm proposes to do expert electrical work, designing, manufacturing, calibrating, etc. As far as manufacturing is concerned, the firm will give its special attention to making electrical goods and appliances that cannot be purchased from the stores and supply houses. Mr. Cutler is well known to Chicago electricians as the inventor of the Cutler non-inductive voltmeters and ammeters. He has also had an experience of eight years in central station work and is eminently fitted to handle the high class of work the concern will undertake. Mr. Hammer is also an experienced man in electrical manufacturing, having been for some time general manager of the Chicago Electrical Manufacturing company. With a factory thoroughly equipped for general testing and calibrating work the new firm starts out with every prospect of securing a good share of the speciality business. It may be said in this connection that Messrs Cutler & Hammer are just now fitting up eight elevators at the World's Fair with the Armstrong flush light elevator annunciator. This is, however, but one of a number of devices now being developed and perfected in the Cutler-Hammer factory.

ELECTRICAL PATENTS.

Issued March 14, 1893

493,243. Electric Switch. William F. Bossert, Utica, N. Y.

493,245. Ear Attachment for Telephones. George McC. Brown, Nashville, Tenn.

The ear tube is connected to the ordinary receiver by means of a hollow rubber bulb attached to the ear tube, which contracts around the receiver. The ear tube diverges into a pair of tubes provided with lips for insertion into the ears.

493,253. Signaling Telegraph. William E. Decrow, Boston, Mass.

The time when a signal is received and registered at the central office is automatically recorded on the register strip. The device also acts as an indicator to make known any fault in the line by reason of which the register fails to operate, although the box may be pulled and the circuit breaker wheel act in its normal manner.

493,277. Method of Electro Depositing Metals. Orazio Lugo, New York, N. Y.

493,297. Acoustic Telephone. Thomas B. Rogers, Brooklyn, N. Y.

493,304. Telephone Index. Stillman L. Shaffer, Worcester, Mass.

493,313. Dynamo-electric Machine. Elihu Thomson, Swampscott, Mass.

493,314. Lightning Arrester. Elihu Thomson, Swampscott, Mass.

The lightning arrester comprises, besides the discharge plates and arcrupturing devices commonly employed, a resistance in the ground connection which possesses little or no inductive character so that the least possible opposition is given to the passage of lightning discharges, but which is as non-conductive as possible, so that the line current, tending to follow the discharge to ground, meets with such a resistance that the arc is broken.

493,325. Multiple Terminal Cut-out. Lark P. Bonebrake, Marysville, Mo.

A number of levers extending radially are so pivoted that their outer ends lie in a circle, the outer end of each being connected by means of fuse wires with a bar forming a part of the circuit. Against the inner end of the first lever bears the end of a spring pressed lever connected in the circuit and adapted to complete the circuit through the fuse wire. When the fuse is blown the spring pressed lever acts to turn the radially placed lever upon its pivot, thus separating the ends of the ruptured fuse wire. The spring pressed lever then makes contact with the second radial lever of the series thus automatically closing the circuit through another fuse wire.

493,337. Armature for Dynamo-electric Machines. Horace F. Parshall, Lynn, Mass.

The armature comprises an annular core fitting and surrounding an internal concentric support, the core and support being connected by means of keys so that motion of the one independent of the other is prevented.

493,346. Personal Equation Chronograph. Lionel De L. Wells, London, Eng.

493,349. Armature for Motors and Generators. Norman C. Bassett, Lynn, Mass.

The armature core is provided with grooves to receive the coils, the sides of the grooves inclining toward each other near the surface of the armature, so that binding pieces may be crowded down upon the coils by means of the inclined sides to hold the coils in position.

493,358. Electric Search Light. Rudolph M. Hunter, Philadelphia, Pa.

493,359. Electric Arc Lamp. Rudolph M. Hunter, Philadelphia, Pa.

The invention is designed to produce a large crater upon the end of the horizontal or reflecting carbon of that class of arc lamps in which the carbons are fed at right angles to one another. The horizontal carbon forms the positive electrode in which the crater is formed, and, instead of a single vertical or negative carbon, several are provided disposed around the circumference of the positive carbon in order to distribute the crater over the entire end of the carbon. As the difficulty of feeding increases with the number of negative carbons, but two of them are used, and in order to distribute the crater uniformly over the end of the positive carbon, the positive carbon or the frame carrying the negative carbons is rotated about the axis of the positive carbon, thus subjecting all parts of the circumference of the positive carbon to the influence of the arc.

493,360. Electric Arc Lamp. Rudolph M. Hunter, Philadelphia, Pa.

The lamp is designed for use upon the ends of slender mast arms and the like, where it is desirable to have the weight of the lamp a minimum. The carbons and carbon holders are suspended upon the end of the arm, while the feeding mechanism is stationed upon the base of the post, and is connected by means of a cord with the carbons.

493,361. Switch for Electric Motors. Moritz Immisch, London, Eng.

493,369. Electric Switch. Alfred Stromberg, Chicago, Ill.

The district to be protected, whether it be a safe, window or the like, is covered by a flexible curtain interwoven with conductors forming an electric circuit in which is included a resistance. The conductors at the protected district are connected by means of a wire with the central office, the return being through ground. At the central office is provided a pair of electro-magnets included in circuit with the line, the strength of one magnet being so adjusted that under normal conditions the current is insufficient to cause it to attract its armature, but when the resistance in the line is cut out by crossing or grounding the wires at the protected district the electro-magnet attracts its armature to close a bell circuit and sound an alarm. The other electro-magnet is normally excited to attract its armature, and when the circuit at the protected district is for any reason broken, the armature drops to close a bell circuit and sound an alarm. In this manner an alarm is sounded at the central office whenever the lines at the protected district are broken, short circuited, crossed or grounded.

493,375. Balanced Armature for Dynamo-electric Machines or Electric Motors and Method of Balancing Same. Gano S. Dunn, New York, N. Y.

The method of balancing consists in providing a number of longitudinal holes in the armature core, the winding being so arranged that the ends of the holes will be exposed when the winding is completed, and placing in the holes plugs of lead adjusted as to weight so that the armature may be balanced, after which the ends of the plug are caused to grip the interior of the hole by means of a punch driven into the ends, thus causing them to spread.

493,380. Combined Cut-out and Lightning Arrester. Ernst F. Hammarstroem, Stockholm, Sweden.

The cut-out and lightning arrester comprises an open ring composed of two different kinds of metal welded together and rigidly connected with a bearing to which the line wire is connected. The ends of the ring rest upon a spring connected with the other pole of the source of current, the circuit being normally from the ends of the ring to the spring. When an abnormal current traverses the circuit the ring is caused to expand until its ends cease to overlap the spring, when the latter flies up, breaking the circuit.

493,411. Base for Electric Light Brackets. James T. Robb, Mount Vernon, Ill

493,422. Electrically Heated Vessel. John V. Capek, New York, N. Y.

493,423 Safety Device for Elevator Shafts. Albert D. Caywood, Chicago, Ill.

493,425. Electric Locomotive. Thomas A. Edison, Llewellyn Park, N. J.

493,431. Electric Motor for Dental Work. Jeremiah Keller, Canton, O.

493,434. Insulator Pin. Fred M. Locke, Victor, N. Y.

493,439. Commutator for Dynamo-electric Machines and Method of Constructing Same. Alexander W. Meston, St. Louis, Mo.

493,446. Support for Electric Lamps. John R. Protzman, Streator, Ill.

493,447. Armature Connection for Dynamo-electric Machines. George A. Rollins, Chicago, Ill.

493,578. Electric Lamp Supporter. Alvin G. De Witt, Detroit, Mich.

493,601. Thermostat. Thomas W. Shepherd, Peabody, Mass.

493,602. Electric Controlling Device. Thomas W. Shepherd, Peabody, Mass.

493,609. Lamp Socket. Henry P. Ball and Amandus Metzger, Schenectady, N. Y.

493,618. Electric Railway Conduit and Contact. Joel Davis and Reuben M. Huntington, Denver, Colo.

493,620. Telegraph Relay. Samuel P. Freir, East Orange, N. J.

493,623. Electric Railway System. Thomas Harris, Detroit, Mich.

Eugene F. Phillips, Prest. W. A. Hathaway, Treas. W. H. Sawyer, Secy.

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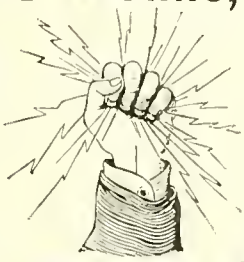

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Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY and MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

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No. 3, 6 Volts 1-12 h. p., $10.00.
No. 4, 10 Volts. 1-8 h. p., $15.00.

Every Motor Guaranteed. Send for Circular

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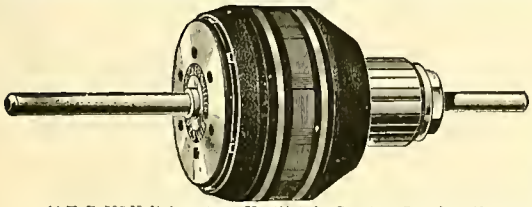

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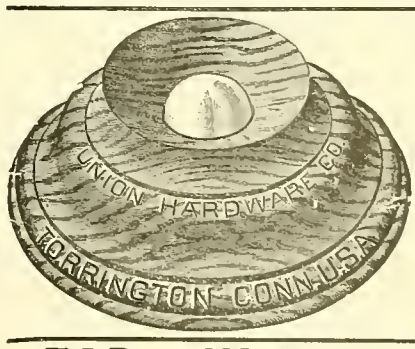

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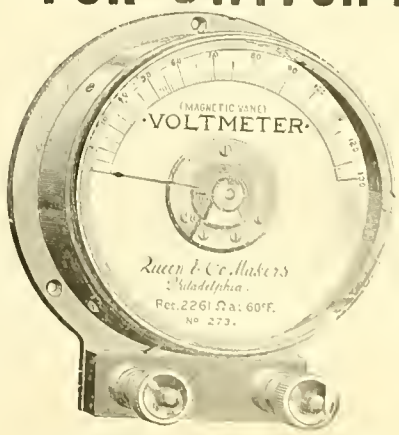

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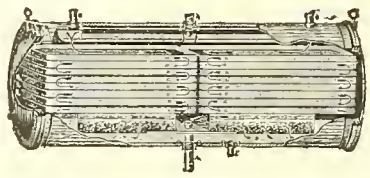

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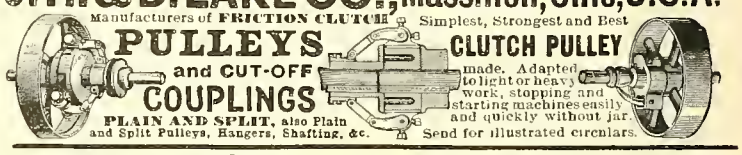

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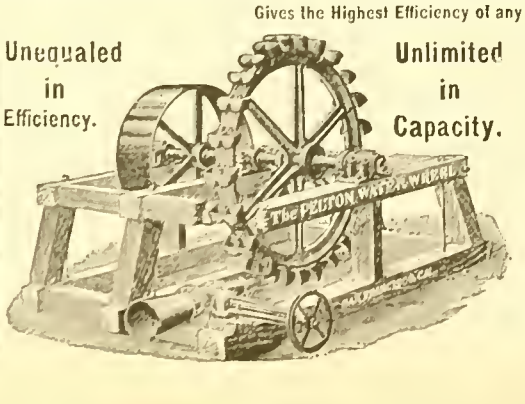

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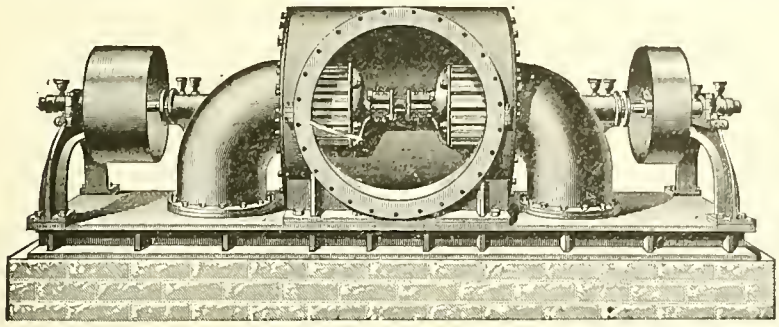

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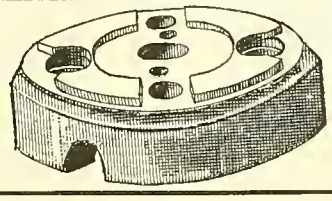

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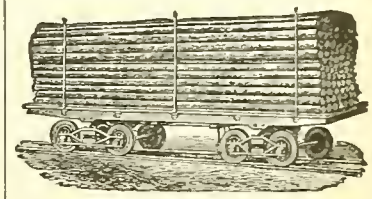

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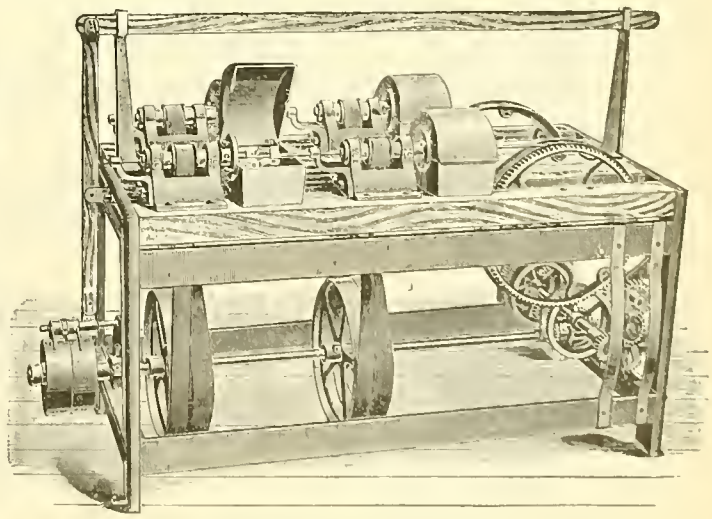

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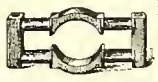

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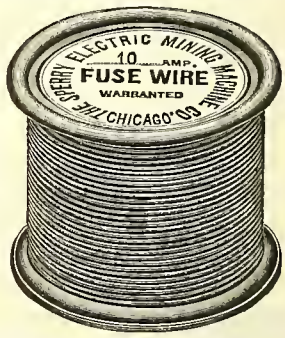

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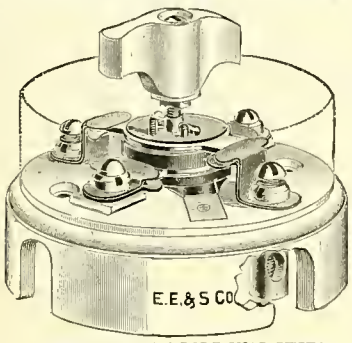

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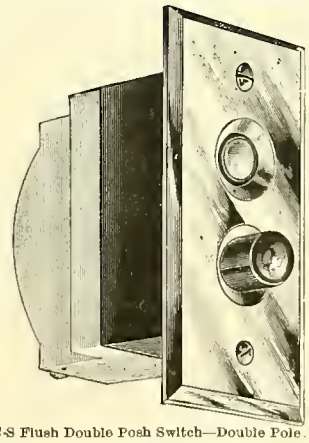

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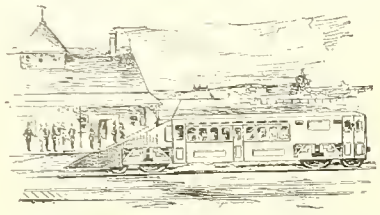

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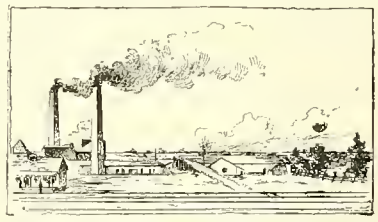


Power House No. 1 of Chicago & St. Louis Electric R. R. at Edinburg, Ill.

A considerable portion of this issue has already been applied for, and will be allotted to these and other advance applicants. The balance of this issue is now offered to the public, and the subscription books will be FORMALLY opened at the offices of the Company, 915-916 "The Temple," Chicago, on the *1st day of April,* at the hour of 10 a. m., and will close on the *10th day of April, 1893,* at 3 o'clock p. m.

Subscriptions will be payable as follows: **20 PER CENT ON APPLICATION. 30 PER CENT ON ALLOTMENT. 50 PER CENT IN THIRTY DAYS AFTER ALLOTMENT.**

Allotments will be made immediately after the close of the subscription books.

The right is reserved to reject any subscription in whole or in part. If any subscription is wholly rejected, the amount deposited on application will be returned. If only a part of the amount applied for by the applicant is allotted to such applicant, the surplus amount paid on application will be applied on the sums due under the allotment.

Preference in the allotment of shares to applicants will be given in the order of the receipt of such applications.

CONSERVATIVE ESTIMATE OF YEARLY REVENUE.

Passenger business (at low estimate of 600 passengers per day at $5.00 each)	$1,095,000	Light and power distribution (5,000 horse power; allowing an average of $200 per year per H. P.)	$1,000,000
Mail business	300,000		
Express business	500,000		
			$2,895,000

YEARLY EXPENSES.

Operating expenses, depreciation of plant, wear and tear, etc., per year	$450,000	Total	$870,000
Interest on $7,000,000 of bonds at 6 per cent per annum	420,000		
		Net earnings	$2,025,000

Equivalent to 29 per cent. on capital stock.

It is believed by competent judges that the stock of this company will in a short time demonstrate to the holder that it is second to none other in this country as a dividend producer. It is a well-known fact that the electric telegraph, the electric telephone, the electric light and the electric street railway securities of this country have, in the main, proved superior to all others.

REGISTRAR AND TRUSTEE FOR THE BONDS:

FARMERS' LOAN & TRUST CO., NEW YORK.

TRUSTEE FOR THE STOCK:

ST. LOUIS TRUST COMPANY, ST. LOUIS.

PERMANENT DEPOSITORY:

FIRST NATIONAL BANK, CHICAGO, ILL.

Since work was begun on the road-bed, Oct. 6, 1892, the progress of the road has been of a most satisfactory nature. While perhaps slower than enthusiasts might desire, yet the progress has been steady and sure and of a character to engender confidence in the skeptical. A contract was let at first calling for grading through Christian County, but since then a contract for the complete road-bed from Chicago to St. Louis has been awarded to Bagnell Bros. of St. Louis, and Garvey Bros. of Memphis. It includes grading, ties, rails, steel bridges over rivers, culverts, steel bridges over railroads, overhead crossings of all wagon roads, and, in fact, a complete standard, double track road-bed between the cities named, everything being of standard steam construction. This contract is most valuable, as the contractors accept *one-half of the total payments in first mortgage Bonds of the company at par.* Moreover the contract price is well within the first estimates of the company, and stops the adverse criticism that was aroused by the low figure at which the cost of the road was placed. While coming well within the estimates upon which the financial plan of the company has been laid, the specifications have been so added to and improved as to make the road far superior to the one first contemplated. 72 pound steel rails are to be used, all bridges over railroads are to be of steel, spanning the right-of-way of the road which is crossed.

The Bill before Congress has met with very promising success. The bill was first introduced by Senator Vest in the Senate and Congressman Foreman in the House, and has already been favorably reported by the Committees on Commerce and on Finance of the Senate. The bill has a splendid chance of being passed.

The financial condition of the company is excellent, and ample funds are on hand to carry on the work contemplated, such as procuring the rest of the right-of-way, and getting things in condition to begin work in earnest this spring.

The Chicago & St. Louis Electric Railroad Company at first had the honor of calling itself the pioneer in long distance rapid transit by electricity, but to-day we have rivals, for the press of this country states that enterprising little Belgium will run trains at nearly 150 miles an hour during the coming summer, and that France and Germany are each to have a road over which trains will be run at more than 100 miles an hour. Six months or a year ago, there were very few persons who would admit the possibility of running trains at 100 miles an hour. Happily for us the sentiment has changed, and it is now admitted almost universally that the only question is one of finance.

The company will be glad to furnish illustrated prospectus upon application at this office.

The Chicago & St. Louis Electric Railroad will be built, and trains will run over it at the rate of *100 miles an hour.*

CHICAGO AND ST. LOUIS ELECTRIC RAILROAD CO.

WELLINGTON ADAMS, Sec'y and Gen'l Manager. *FRANCIS E. NIPHER, President.*

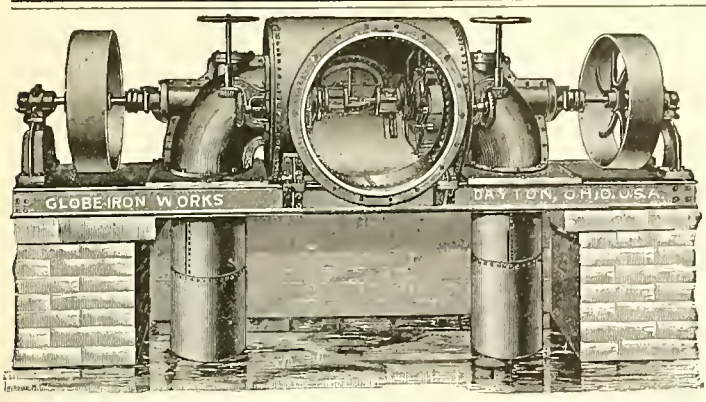
Those who want to make certain of securing some of this present issue of stock at this figure may make Advance Application at the office of the Company.

Money may be sent by registered letter, P. O. money order, express, draft or bank cashier's check to

C. E. BLEYER, Ass't General Manager,

CHICAGO & ST. LOUIS ELECTRIC RAILROAD COMPANY,

915-916 "THE TEMPLE," CHICAGO.



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On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

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Our Individual Arc Light and Motor Cut-Outs

ARE

RELIABLE,

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And Require Only One Small Wire.

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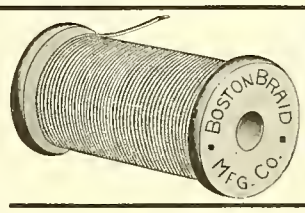

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For Incandescent Lamp Filaments.

The greatest care taken in producing a uniform article.

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Street Railway and Electric Lighting Companies will find it to their interest to write for prices, as we do all kinds of electrical repair work.

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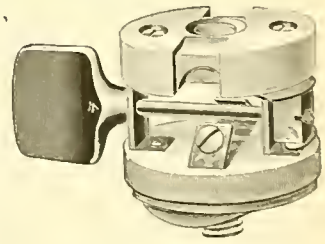

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THE STANDARD OPEN CIRCUIT BATTERIES OF THE WORLD,
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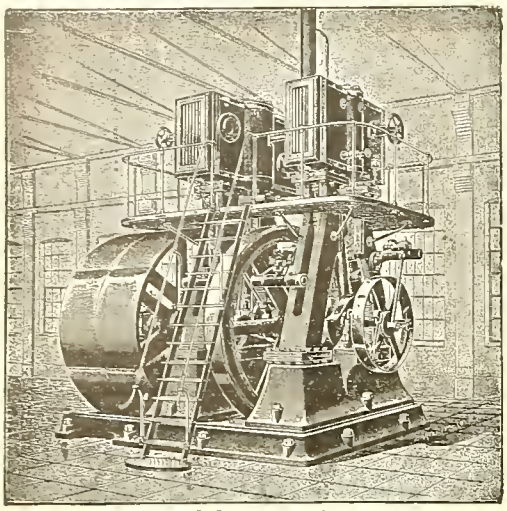

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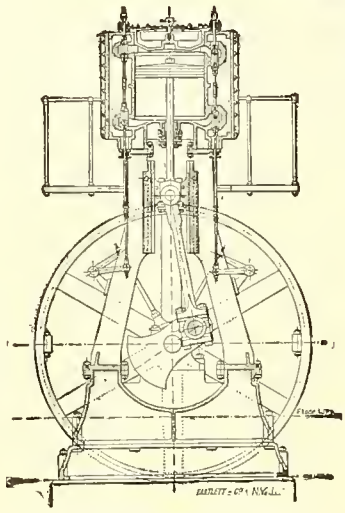

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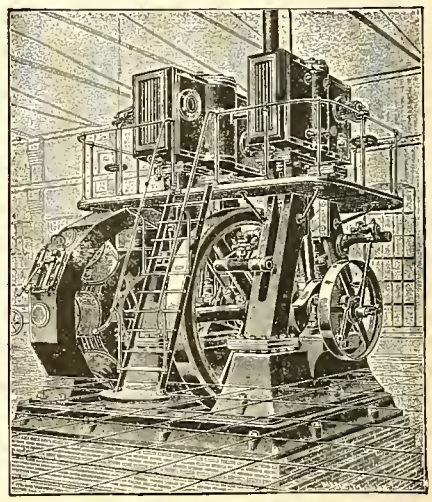

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WRITE FOR PARTICULARS.

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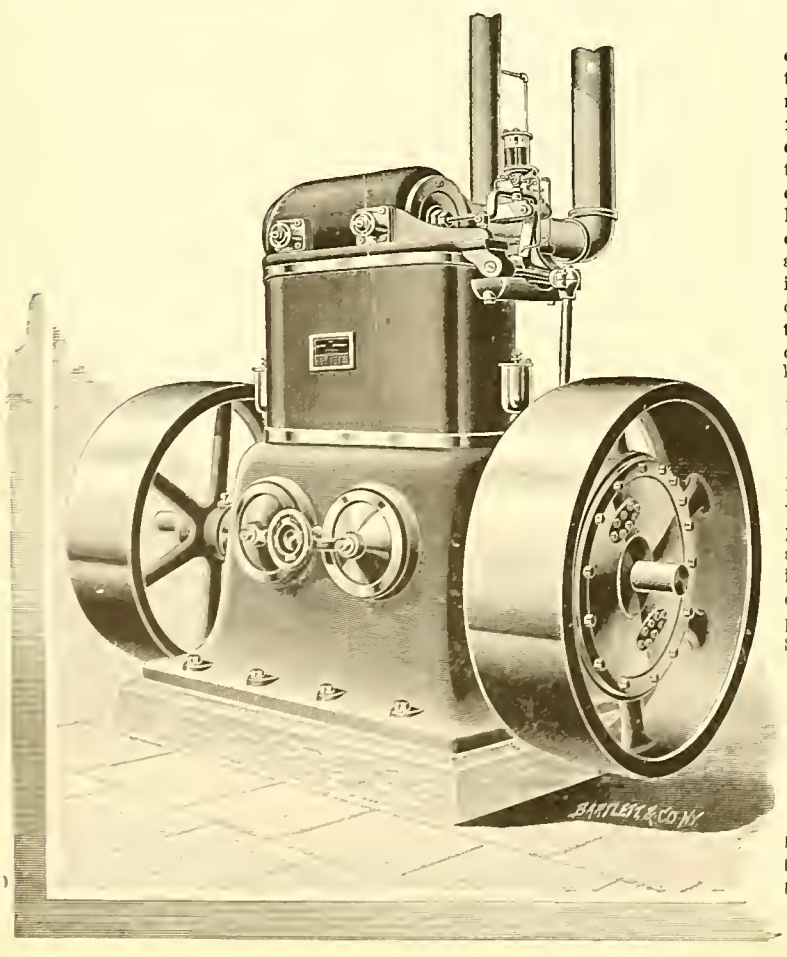

The Compound Engine, when non-condensing, so far from possessing an economy superior to the Simple Engine, has been decisively proven, "much to the disgust of the stockholder," to show normal economy only at or about its rated power, and to fall off in economy faster than a Simple Engine as the load falls off; moreover, very much faster under the extreme light loads that are common in Electrical Generation. This point is at last reluctantly admitted by the more candid builders of such engines, most of whom now advise against compounding for variable loads. The reason is in their inability to divide the load and range of temperature proportionately and automatically between the cylinders at all points of cut-off. Hence, the low-pressure cylinder expands its steam below atmosphere under a moderately early cut-off, thus converting itself into an Air Pump, and becoming a load upon the high-pressure cylinder instead of a co-laborer with it. This point was distinctly foreseen by the designers of the Westinghouse Compound Engine, and an entirely new principle was worked out, making expansion below atmosphere impossible under any load, however light. **For the first time in the history of Steam Engineering, either Simple or Compound, is built an Engine which maintains essentially uniform economy, irrespective of load,** and hence for the first time the Compound Non-condensing Engine has been made practicable. The results, demonstrated by test, show that where an ordinary Compound will range from 25 lbs. to 70 lbs. water per H. P per hour from full to quarter load, the Westinghouse Compound, between the same limits, will range from 23 lbs. to 29 lbs. We have not deceived ourselves in this matter, and propose that the facts shall be understood. To those interested in the nicer points involved, we will be pleased to send a reprint of the paper read by Mr. F. M. Rites on this subject at the late meeting of the American Society of Mechanical Engineers, at San Francisco.

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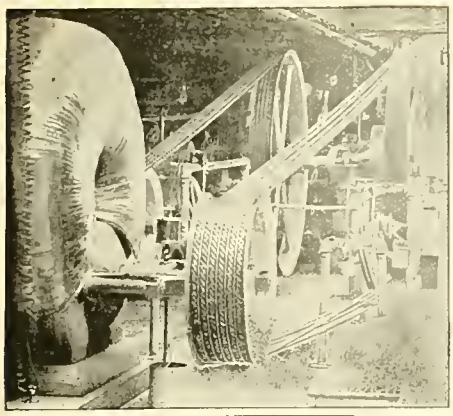

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Rope Transmission

in the Chamber of Commerce Building, Chicago, as furnished by us.

By its use a steady light is always maintained.

There is absolutely no slippage, vibration, or noise.

The rope, when worn out, can be replaced readily at a small cost.

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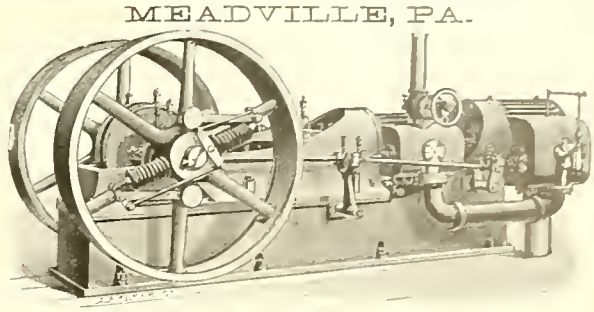

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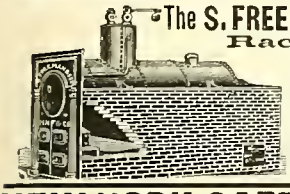

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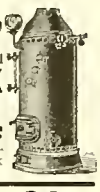
Estimates promptly furnished. Large illustrated Catalogue sent free to any address. Ask for "Catalogue B," and mention this paper.



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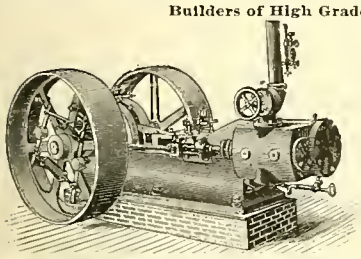

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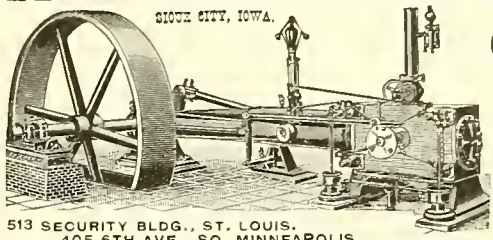

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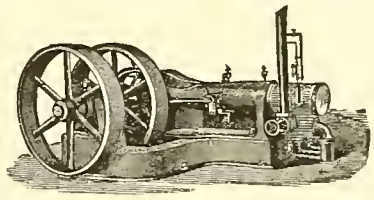

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Two horse power to three hundred horse power.

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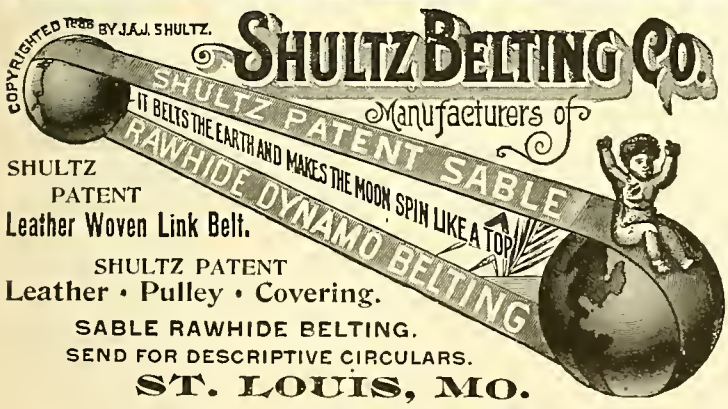

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Leather • Pulley • Covering.

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DO your BELTS BLACKEN the CEILING, the WALLS, or the FLOOR?

If so you don't know anything about

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We make a Specialty of Dynamo Belts.

You can get some interesting information and also learn how many things are made of **Rawhide** by writing to

THE CHICAGO RAWHIDE MFG. CO.,
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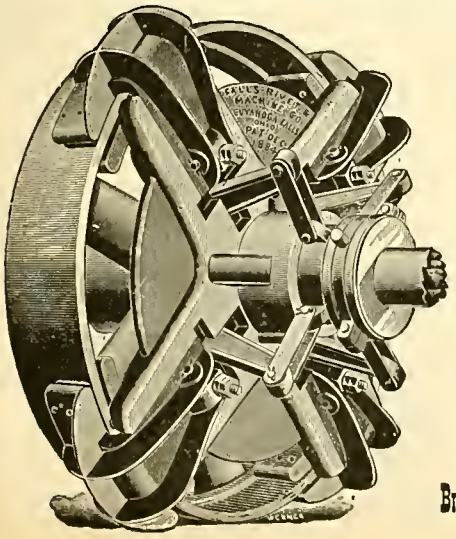

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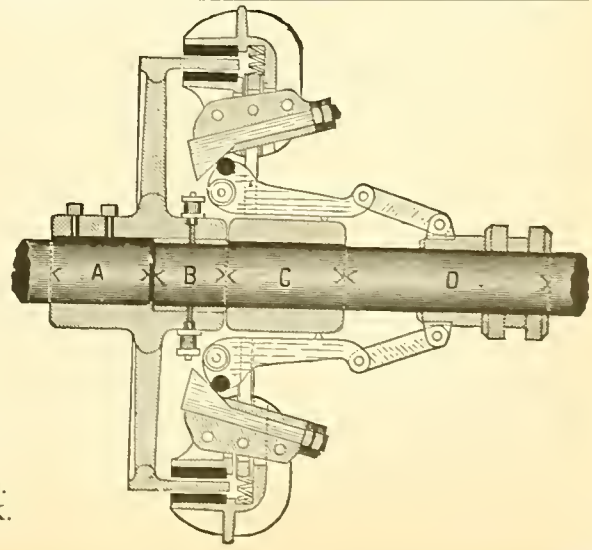

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THERE ARE IN THE UNITED STATES TO-DAY

6,000 MILES

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A RECORD UNRIVALED IN STREET RAILWAY HISTORY.

415 ROADS.

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THE ABOVE FIGURES AFFORD THE MOST CONVINCING PROOF OF THE

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Have been appointed exclusive agents for the

Ries Regulating Sockets

For Alternating Currents, for the States of

Illinois, Indiana, Western Ohio, Michigan, Iowa, Wisconsin, Minnesota, Missouri and Colorado.

The **RIES REGULATING SOCKET** places Incandescent Electric Lighting, commercially speaking, on a par with gas. It enables the consumer to burn his lamps at any desired degree of brilliancy, from a barely perceptible glow, consuming but a fraction of normal current, up to the full Candle Power of Lamp.

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It means increased efficiency, increased output, increased dividends. It is easily wired, nothing to get out of order, no straining of lamp filaments, indispensable for stores, private houses, hotels, hospitals, etc. Indorsed by underwriters and leading Electrical Engineers.

TO THE CONSUMER

It regulates the light, it saves the current, it prolongs the life of the lamp. It is compact and simple, efficient and economical, and saves its cost several times over every year.

Further particulars and prices upon application.

THE KNAPP ELECTRICAL WORKS,

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JUST BEAR IN MIND

That The Ansonia Electric Co. is only the new name of the same old company that for years you have known as The Electrical Supply Co., and we will continue to manufacture that insulated wire that you have learned to know as Shield Brand Moisture Proof--it holds its own--don't leak water in, nor leak the current out.

TEXT: ***Special lighting means a special profit.***

THE

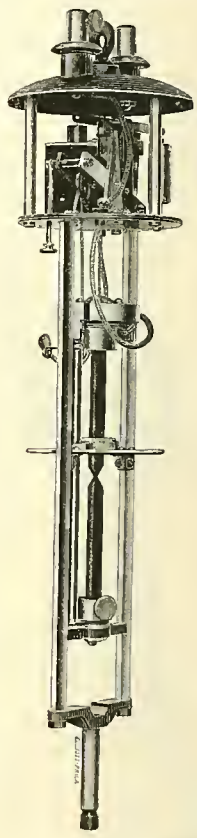
HELIOS LOW TENSION

ALTERNATING

ARC LAMP.

A NOISELESS, STEADY LIGHT.

For consumer and station manager alike, the Helios Arc Lamp brings with it immunity from the fire risk and freedom from the fear that haunts every user of a direct high tension series system. This application of the alternating current combines the safety of low tension with the range and flexibility of the high—and no greater merit than that could be claimed.



There is no fact more familiar in electric lighting than the turning on of series arc circuits two or three hours before the set time simply because half a dozen lamps are required in advance of the schedule. This means a steady loss. *With the Helios Alternating Arc Lamp, special lighting means a special profit.* Another aspect of the case is that in incandescent lighting territory many customers want arc lights regularly during the daylight hours in large stores, bank vaults, hotel corridors, dark courtyards and basements. As it is not the practice to operate arc circuits in the day, all that business is likely to be lost; but an alternating station using Helios Arc Lamps can take care of it handsomely. It is no longer a question of limited demand or of unproductive outlay, but an exact adjustment of the conditions of production and consumption.

Superior mechanically and electrically. Requires no additional apparatus or system of wiring. Cheaper to operate than any other lamp. ABSOLUTELY SAFE. Not liable to get out of order. Current can be measured by meter.

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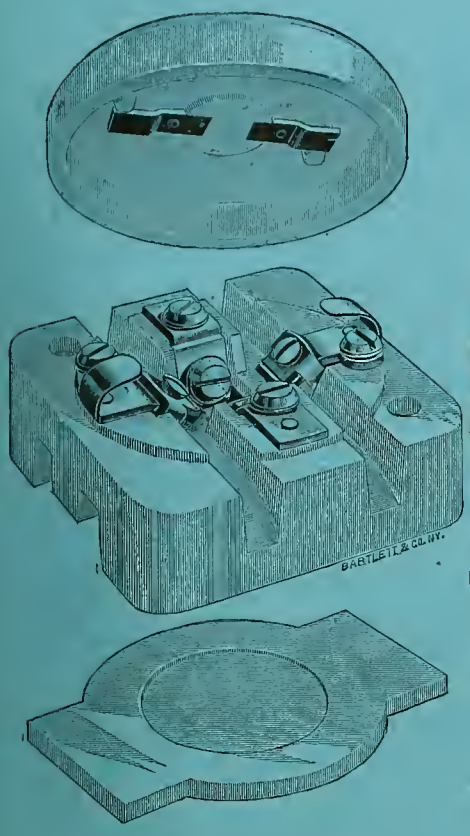
Factories and Eastern Offices: ANSONIA, CONN. **CHICAGO.**

Sockets, Switches, Cut-outs

AND GENERAL ELECTRICAL SUPPLIES.



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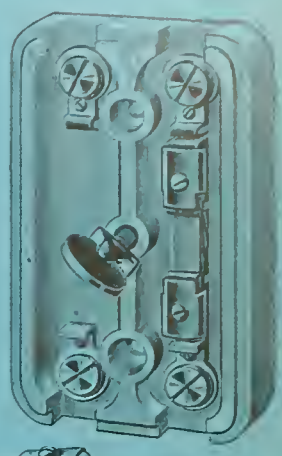

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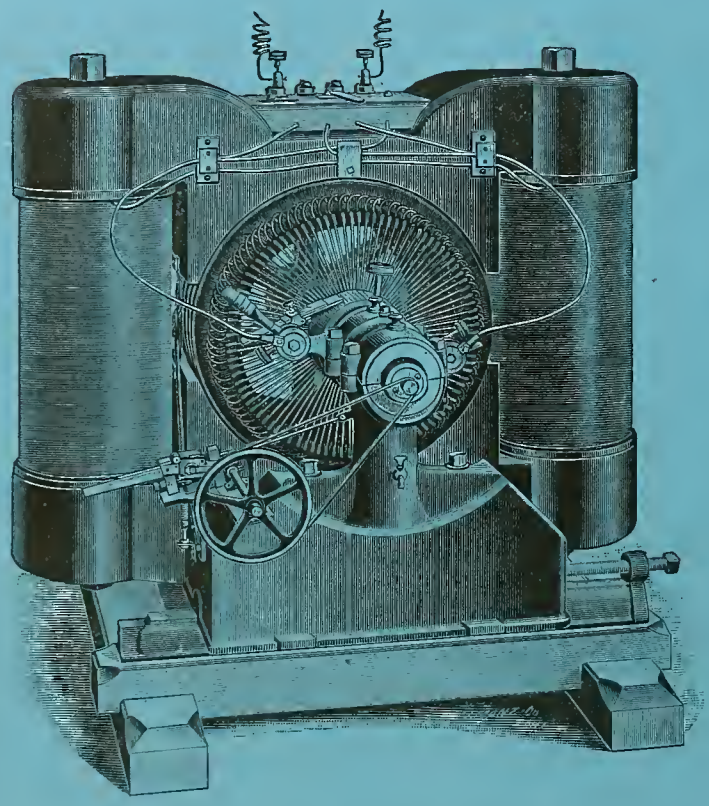

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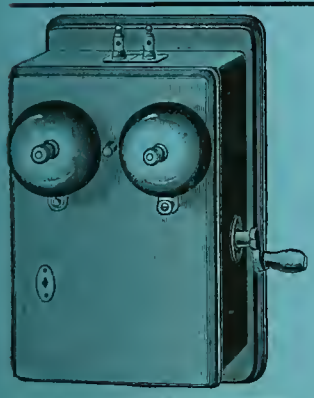

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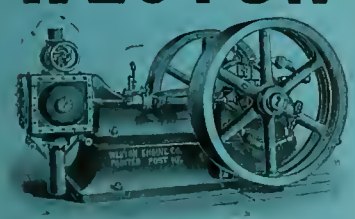

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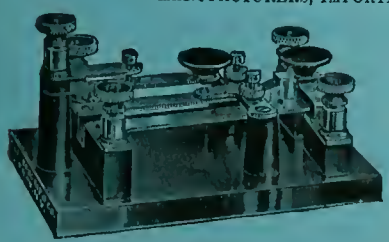

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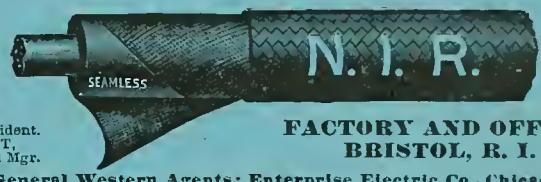

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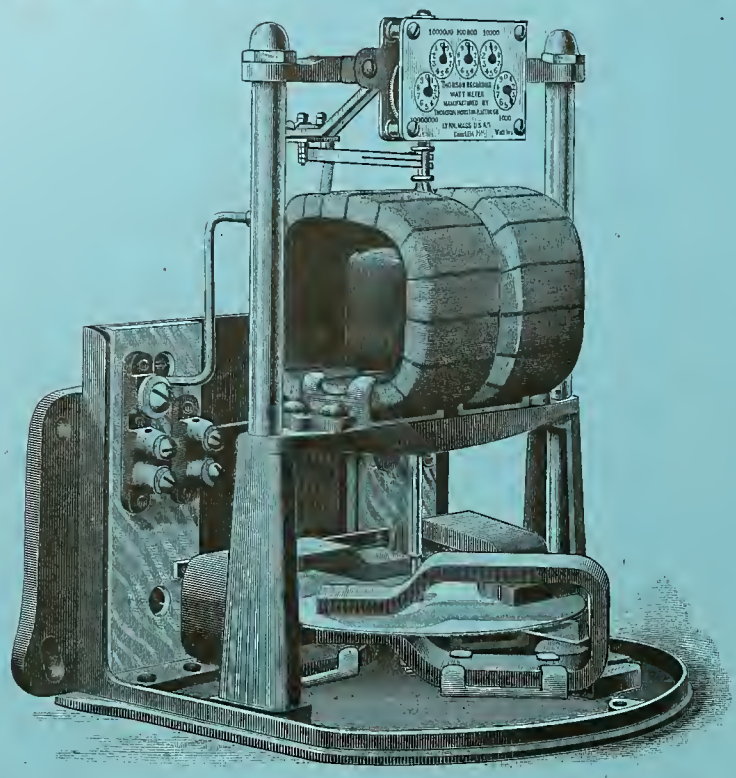

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Greeley & Co., The E. S.
Knapp Electrical Works.
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Leclanche Battery Co., The.
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Western Electric Co.

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American Battery Co.
Butler Hard Rubber Co.
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Jewell Belting Co.
Link Belt Machinery Co.
Page Belting Co.
Shultz Belting Co.

Boilers.
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Blanchard, Albert.
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Lane & Bodley Co., The.
N. Y. Safety Steam Power Co.
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General Electric Co.
Knapp Electrical Works.
New York and Ohio Co.
Sawyer-Man Electric Co.
Steuben Lamp Works.

Lathes.
Bridgeport Machine Tool Works.
Shepard, H. L.

Lightning Arresters.
Knapp Electrical Works.

Magnet Wire.
(See Insulated Wires.)

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Bridgeport Machine Tool Works

Medical Batteries.
Partrick & Carter Co.

Mica.
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

Mining Apparatus, Electric
General Electric Co.
Great Western Mfg. Co
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

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C. & C. Electric Motor Co.
Calumet Elec. Mfg. & Engr. Co.
Crocker-Wheeler Electric Co.
Eddy Electric Mfg. Co.
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Acme Filter Co.

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Electrician Publishing Co.

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(See electric railways.)

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Ansonia Electric Co., The.
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Knapp Electrical Works.
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Telephone Mouthpieces.
Marcus, W. N.

Test Instruments.
Central Electric Co.
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Knapp Electrical Works.
Queen & Company.
Western Electric Co.
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STREET LIGHTING FROM ALTERNATING CURRENT DYNAMOS.

New Prices given on Lamps, Street Fixtures, Bank Boards, Series Sockets, Poles, Meters

And all accessories for the use of SERIES LAMPS on ALTERNATING CURRENT DYNAMOS.

This system permits a PROFITABLE and SATISFACTORY method of street illumination and should be investigated by every plant using alternating current apparatus. WRITE FOR FURTHER PARTICULARS AND PRICES.

OUR SERIES LAMPS

Will show you a COMPARATIVE SAVING equal to their FIRST COST in POWER CONSUMED.

BERNSTEIN ELECTRIC COMPANY, 620 Atlantic Ave., Boston, Mass.

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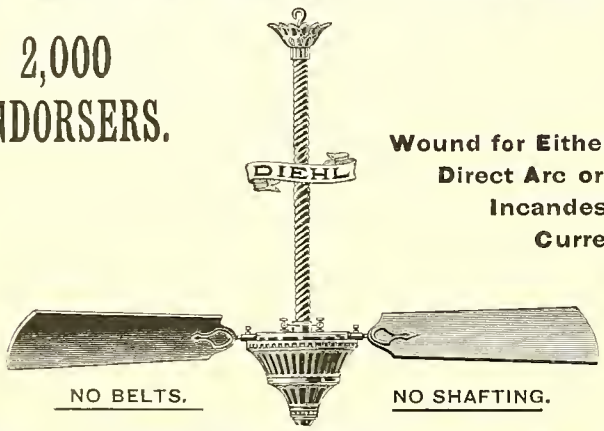
2,000 ENDORSERS.



Wound for Either Direct Arc or Incandescent Current.

NO BELTS. NO SHAFTING.

DIEHL & COMPANY, 385 Broadway, New York.

Only Successful Alternating Current Arc Lamp.

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LOW TENSION ALTERNATING CURRENT ARC LAMPS.

Over 30,000 Helios Lamps in daily operation in Europe, and more than 1,000 Lamps already in operation in America. The only Arc Lamp which burns as steadily as an Incandescent Lamp. Most economical Arc Lamp for Central Station or Consumer. **Write us for our New Catalogue.**

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Eastern Agents: STANLEY ELECTRIC MFG. CO., Pittsfield, Mass.
Western Agents: THE ANSONIA ELECTRIC CO., Chicago, Ill.
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Chicago Insulated Wire Co.,

MANUFACTURERS OF

INSULATED WIRES OF ALL KINDS.

TRADE MARK. INSULATED CHICAGO

214 Northern Office Building, CHICAGO.

Weatherproof Wire.
Water-Fire Proof Wire.
Magnet Wire.
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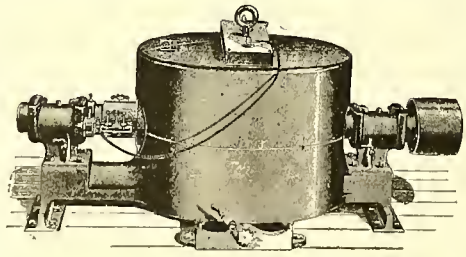
Bare Copper Wire.

THE

Rockford Dynamo AND Motor.



SIMPLE ECONOMICAL EFFICIENT

ROCKFORD ELECTRIC MANUFACTURING CO.,

ROCKFORD, ILL.

Boston Electric Company,

548 Washington St., Boston,

MANUFACTURERS OF THE

Original Celebrated Boston Burners.

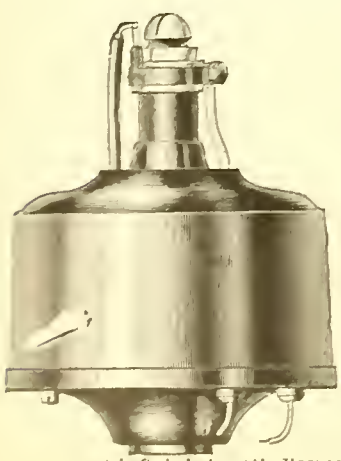
HEADQUARTERS FOR

GAS LIGHTING APPARATUS.

Please do not confuse our name with others.

We have the largest and most complete stock of Gas Lighting apparatus to be found in this country. Our burners have proven, by practical use, to be far superior to any others on the market, and our prices are exceedingly low.

Buy burners made by the BOSTON ELECTRIC CO., and get the best. You will thereby save the profits of your labor, besides giving your customers perfect satisfaction.



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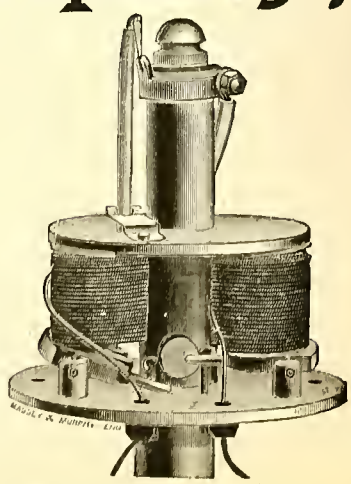

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CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin Street, Chicago.

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

Western Electrical Supply Co.,
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Gate City Electric Co.,
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Southern Electrical Supply Co.,
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NATIONAL ELECTRIC MANUFACTURING COMPANY,

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—BUILDERS OF—

High Grade Dynamo Electric Machinery.

APPARATUS FOR ALL PURPOSES.

Long Distance Transmission of Power,
Stationary Motors and Appliances,
Isolated Lighting Plants,
Street Railway Generators,
Electric Mining Plants,
Central Station Lighting,
Alternating or Direct Current.

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136 Liberty Street, NEW YORK.
Penn Mutual Building, PHILADELPHIA.
65 Smith Building, CINCINNATI.
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Equitable Building, ST. LOUIS.
Pullman Building, CHICAGO.
134 East Sixth Street, ST. PAUL.
29 E. First South Street, SALT LAKE CITY.
Haller Building, SEATTLE, WASH.
314 California Street, SAN FRANCISCO.
70 Pearl Street, TORONTO, ONT.

The Place to Buy Supplies:

THE ELECTRICAL ENGINEERING AND SUPPLY CO.,

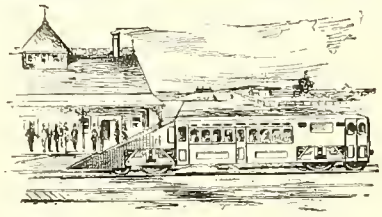
ST. PAUL, MINN.,

Is the leading supply house of the North-West. Moderate Profits. Prompt Shipments.
Send us a trial order and see what we will do for you.

The Chicago & St. Louis Electric R. R. Co.

Has let contracts for the entire construction of its road-bed, and now offers an additional issue of fifty thousand shares of its capital stock at ***six dollars per share, full paid and non assessable, par value ten dollars.***

THE CAPITAL STOCK IS SEVEN MILLION DOLLARS, DIVIDED INTO SEVEN HUNDRED THOUSAND SHARES.



Prospective Station on line of Chicago & St. Louis Electric R. R.

A considerable portion of this issue has already been applied for, and will be allotted to these and other advance applicants. The balance of this issue is now offered to the public, and the subscription books will be FORMALLY opened at the offices of the Company, 915-916 "The Temple," Chicago, on the ***1st day of April,*** at the hour of 10 a. m., and will close on the ***10th day of April, 1893,*** at 3 o'clock p. m.

Subscriptions will be payable as follows: **20 PER CENT ON APPLICATION. 30 PER CENT ON ALLOTMENT. 50 PER CENT IN THIRTY DAYS AFTER ALLOTMENT.**

Allotments will be made immediately after the close of the subscription books.

The right is reserved to reject any subscription in whole or in part. If any subscription is wholly rejected, the amount deposited on application will be returned. If only a part of the amount applied for by the applicant is allotted to such applicant, the surplus amount paid on application will be applied on the sums due under the allotment.

Preference in the allotment of shares to applicants will be given in the order of the receipt of such applications.

CONSERVATIVE ESTIMATE OF YEARLY REVENUE.

Passenger business (at low estimate of 600 passengers per day at $5.00 each)	$1,095,000	Light and power distribution (5,000 horse power; allowing an average of $200 per year per H. P.)	$1,000,000
Mail business	300,000		
Express business	500,000		
			$2,895,000

YEARLY EXPENSES.

Operating expenses, depreciation of plant, wear and tear, etc., per year	$450,000	Total	$870,000
Interest on $7,000,000 of bonds at 6 per cent per annum	420,000		
		Net earnings	$2,025,000

Equivalent to 29 per cent. on capital stock.

It is believed by competent judges that the stock of this company will in a short time demonstrate to the holder that it is second to none other in this country as a dividend producer. It is a well-known fact that the electric telegraph, the electric telephone, the electric light and the electric street railway securities of this country have, in the main, proved superior to all others.

REGISTRAR AND TRUSTEE FOR THE BONDS:

FARMERS' LOAN & TRUST CO., NEW YORK.

TRUSTEE FOR THE STOCK:

ST. LOUIS TRUST COMPANY, ST. LOUIS.

PERMANENT DEPOSITORY:

FIRST NATIONAL BANK, CHICAGO, ILL.

Since work was begun on the road-bed, Oct. 6, 1892, the progress of the road has been of a most satisfactory nature. While perhaps slower than enthusiasts might desire, yet the progress has been steady and sure and of a character to engender confidence in the skeptical. A contract was let at first calling for grading through Christian County, but since then a contract for the complete road-bed from Chicago to St. Louis has been awarded to Bagnell Bros. of St. Louis, and Garvey Bros. of Memphis. It includes grading, ties, rails, steel bridges over rivers, culverts, steel bridges over railroads, overhead crossings of all wagon roads, and, in fact, a complete standard, double track road-bed between the cities named, everything being of standard steam construction. This contract is most valuable, as the contractors accept ***one-half of the total payments in first mortgage Bonds of the company at par.*** Moreover the contract price is well within the first estimates of the company, and stops the adverse criticism that was aroused by the low figure at which the cost of the road was placed. While coming well within the estimates upon which the financial plan of the company has been laid, the specifications have been so added to and improved as to make the road far superior to the one first contemplated. 72 pound steel rails are to be used, all bridges over railroads are to be of steel, spanning the right-of-way of the road which is crossed.

The Bill before Congress has met with very promising success. The bill was first introduced by Senator Vest in the Senate and Congressman Foreman in the House, and has already been favorably reported by the Committees on Commerce and on Finance of the Senate. The bill has a splendid chance of being passed.

The financial condition of the company is excellent, and ample funds are on hand to carry on the work contemplated, such as procuring the rest of the right-of-way, and getting things in condition to begin work in earnest this spring.

The Chicago & St. Louis Electric Railroad Company at first had the honor of calling itself the pioneer in long distance rapid transit by electricity, but to-day we have rivals, for the press of this country states that enterprising little Belgium will run trains at nearly 150 miles an hour during the coming summer, and that France and Germany are each to have a road over which trains will be run at more than 100 miles an hour. Six months or a year ago, there were very few persons who would admit the possibility of running trains at 100 miles an hour. Happily for us the sentiment has changed, and it is now admitted almost universally that the only question is one of finance.

The company will be glad to furnish illustrated prospectus upon application at this office.

The Chicago & St. Louis Electric Railroad will be built, and trains will run over it at the rate of ***100 miles an hour.***

CHICAGO AND ST. LOUIS ELECTRIC RAILROAD CO.

WELLINGTON ADAMS, Sec'y and Gen'l Manager. *FRANCIS E. NIPHER, President.*

Those who want to make certain of securing some of this present issue of stock at this figure may make Advance Application at the office of the Company.

Money may be sent by registered letter, P. O. money order, express, draft or bank cashier's check to

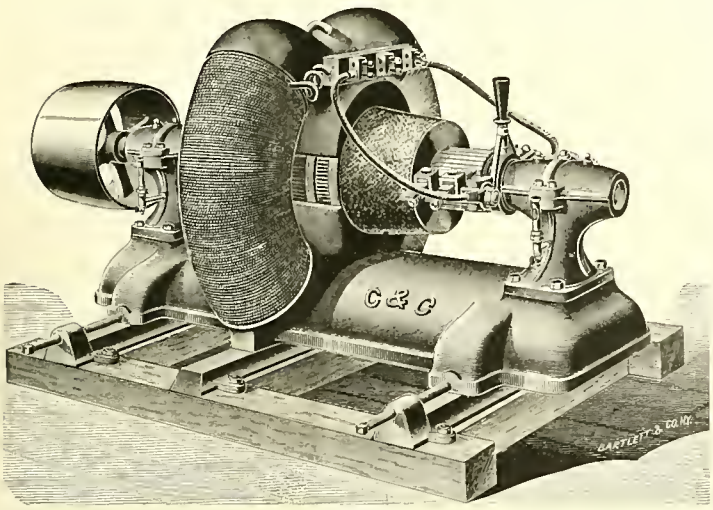
C. E. BLEYER, Ass't General Manager,

CHICAGO & ST. LOUIS ELECTRIC RAILROAD COMPANY,

915-916 "THE TEMPLE," CHICAGO.

C. & C.

Electric Motors and Dynamos.



Electric Lighting and Electrical Transmission of Power.

The C. & C. Electric Motor Co.,

GENERAL OFFICE:
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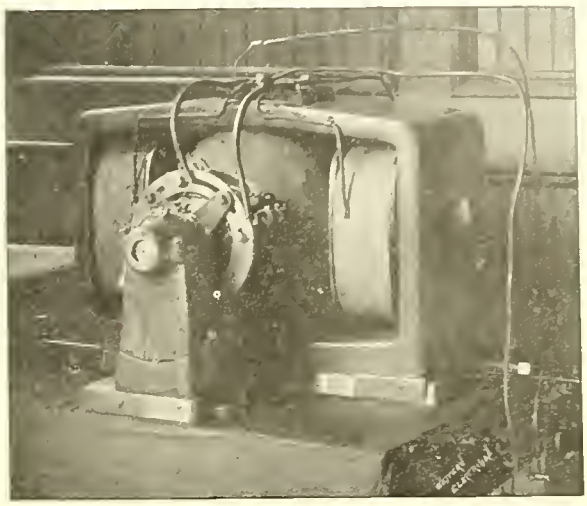
BRANCH OFFICES AND WAREROOMS:
CHICAGO, 201 Madison St. BOSTON, 63 Oliver St.
Agencies in all principal cities.

NEW EDDY MOTOR.



MULTIPOLAR GENERATORS FOR RAILWAY AND POWER PURPOSES.

PERFECT IN CONSTRUCTION.

THE FEATURE OF ST. LOUIS CONVENTION.

Correspondence Solicited.

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WINDSOR, CONN.

136 Liberty Street, NEW YORK.
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1417 and 1418 Monadnock Bldg., CHICAGO.
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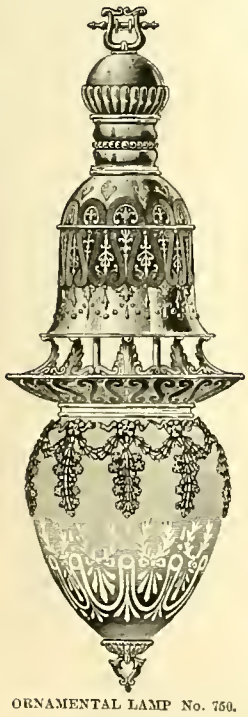
134 E. 6th St., ST. PAUL, MINN.
705 Delaware Street, KANSAS CITY, MO.

S. BERGMANN, President. **C. M. BIDDLE, Vice-President.**

THE "GENERAL" INCANDESCENT ARC LAMP.



ORNAMENTAL LAMP No. 750.

For Low Tension, Continuous Current Circuits.

Soft, Steady Light; Small Size and Weight; Simplicity; Quick Trimming; Thorough Insulation and Safety; Reliability; Large Range of Amperage and Voltage; Longest Life.

No. 1 Circular and Price List of Standard Lamps, No. 2 Circular and Price List of Ornamental Lamps with numerous Illustrations of

ARTISTIC DESIGNS

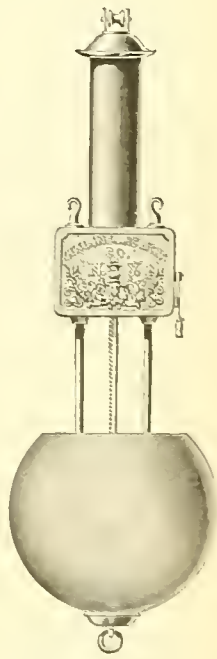
Sent on application, with discounts, etc.

Can be used Singly or from 2 to 12 in series on from 50 to 500 Volts

All Lamps exactly alike in Mechanism.
No Adjustment or Regulation needed.
Can be Trimmed without touching the globe.
No Dash Pot to hide primary defects.

Our Lamp is absolutely Reliable and will not change from use.

Special Designs and Estimates furnished on demand.



STANDARD LAMP No. 500.

GENERAL INCANDESCENT ARC LIGHT COMPANY,

WORKS, 33d Street and First Avenue.
Telephone No. 1309, 38th St.

GENERAL OFFICES, 59 Duane Street.
Telephone No. 163 Cortlandt.

SHOWROOMS, 275 Fifth Avenue.
Telephone No. 1459, 38th St.

NEW YORK.

WESTERN AGENCY: 173-175 Adams St., Chicago, L. E. Frorup, Mgr.

The idea that **ALL** dry batteries "run down" quickly and recuperate slowly, is erroneous so far as the **PHENIX DRY BATTERY** is concerned.

When you have occasion to use **ANY** kind of open circuit battery, try the **PHENIX.**

THE WESTON STANDARD PORTABLE

DIRECT CURRENT VOLTMETERS AND AMMETERS

Are used in all parts of the civilized world. They are recognized by all authorities as the very best instruments ever produced.

During the past year Mr. Weston has given much time to the further study and improvement of these instruments, and has brought them to a higher degree of permanency, durability, accuracy and excellence than we ever thought possible. ***The New Model*** is the same in external appearance as the old, but is vastly superior to the latter in all that contributes to a first-class instrument. It is the ***acme*** of perfection, and is destined to become and remain

THE STANDARD PORTABLE INSTRUMENT OF THE WORLD.

We have perfected a larger model of these instruments expressly adapted for use as ***absolute standards*** in stations and laboratories. They are designated as the

Weston Laboratory Standard Voltmeters AND Ammeters.

The scales are about three times the length of the ordinary portable standards, and the instruments are sufficiently sensitive to work to within 1-75 of one per cent. We confidently recommend them as the most convenient and accurate standards known. They are adapted for the most exact work, and will be found thoroughly equal to its requirements.

We make twenty-two ranges of

The Weston Portable Alternating Current Voltmeters.

These instruments are absolutely permanent and very accurate, and are incomparably superior to any form of hot wire instrument known. They will be found invaluable in securing and maintaining uniformity and economy of operation of alternating current plants. ***We make multipliers for use with these instruments*** to extend their range so as to measure the highest voltage met with on primary circuits.

We also make sixteen different ranges of moderate priced, high grade

Dead-Beat Switch-Board Ammeters.

The capacity ranges from 25 amperes to 750 amperes. These instruments are a new type, and are very accurate and well made. The scales are very regular, the instruments very sensitive, thoroughly durable and absolutely permanent, and their indications are not sensibly affected by the most powerful external fields.

In addition we are making a full line of Direct Current

Station and Isolated Plant Voltmeters,

In three sizes and many ranges. These instruments are very dead-beat, and embody many new and valuable features. They are specially adapted for railway and power plants, and are well suited for arc and incandescent light circuits, and all other work requiring ***good and thoroughly trustworthy voltmeters.*** They are specially designed for switch-board use. We are also making a large line of high grade

Station Ammeters

In ranges from 200 to 5,000 amperes, with absolutely proportional scales throughout the entire range. The sensibility and accuracy of these instruments have never been approached. A 1,200 ampere instrument will indicate, with full load or no load, the turning on or off of a single lamp, and can be read in any part of the scale to one ampere. They are very dead-beat, handsome in design and finish, permanent, durable, well made and moderate in price.

THE WESTON ELECTRICAL INSTRUMENT CO.,

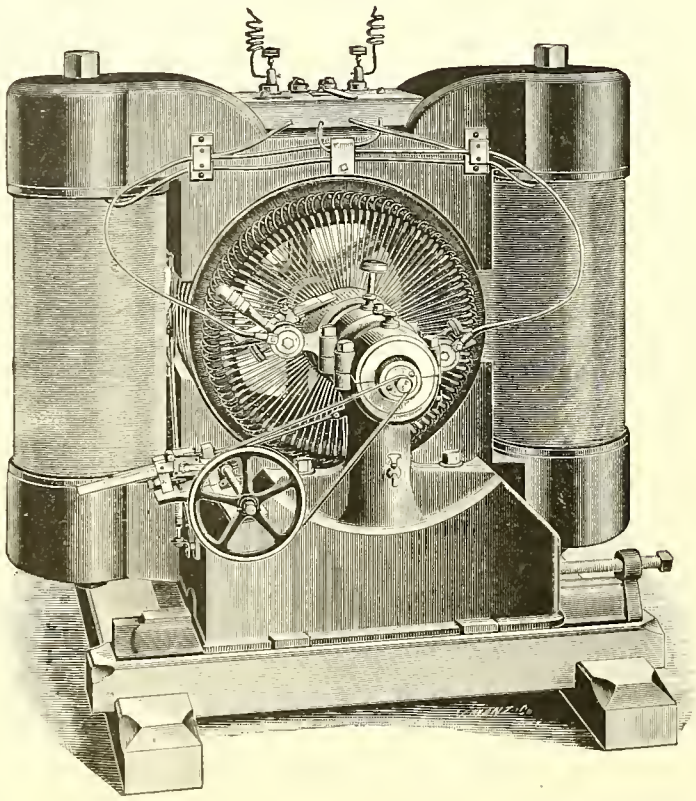
Correspondence Solicited. 114-120 William Street, NEWARK, N. J., U. S. A.

STANDARD ELECTRIC CO.

General Offices: Suite 625, Home Ins. Bldg., CHICAGO.
Works: 313-317 South Canal Street,

BUILDERS OF THE STANDARD SYSTEM OF ARC LIGHTING.

FOR FURTHER INFORMATION



ADDRESS THE GENERAL OFFICES.

NOTICE.

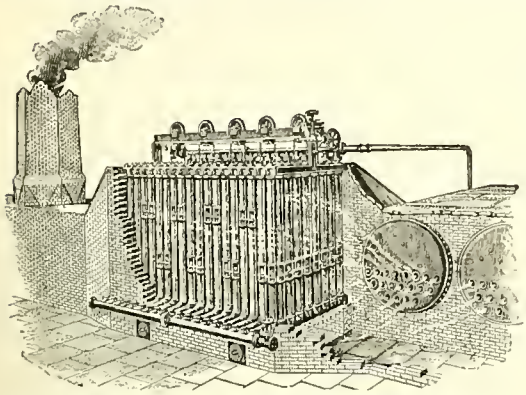
Central Station Managers, Municipal Officers, Owners of Isolated Lighting Plants and Prospective Purchasers everywhere are invited to inspect and investigate the **STANDARD SYSTEM** before contracting for apparatus.

For lighting stores, foundries, factories or the streets of a city, this system has no equal.

Our contract does not obligate the purchaser to buy apparatus or supplies exclusively of us for a term of years, but courts open competition and encourages fair tests for merit between any and all existing arc lighting systems and the STANDARD.

GREEN'S IMPROVED

PATENT FUEL ECONOMIZER FOR STEAM BOILERS.



This apparatus is already applied to over

150,000 BOILERS

of every type, and giving the greatest satisfaction in Economy and Working.

Under favorable conditions the temperature of the Feed Water is raised to 300 degrees or more by utilizing the waste heat of the Boiler flues—the water being thus purified and freed from sedimentary matter, the Heating Surfaces of the Boilers are kept clean and efficient.

All joints iron to iron, no leakage, no trouble, greatest facility for cleaning.

All parts interchangeable, being made to Standard Gauge by Tools specially designed for the purpose.

The only works in the United States devoted exclusively to the manufacture of Fuel Economizers.

Can be Applied to any Type of Boiler without Stoppage of Works.

Circulars, Plans, Specifications and full Information on Application to Head Office.

THE FUEL ECONOMIZER CO., OF MATTEAWAN, N. Y.

Head Office: 91 Liberty St., New York City.
Works: MATTEAWAN, N. Y.

Sole Makers of Green's Fuel Economizer in the United States.

Original Inventors and Makers, EDWARD GREEN & SON, Limited, 2 Exchange Street, **Manchester. Works Wakefield, England.**

SOMETHING TO BE NOTED!

THE MORRISON STORAGE BATTERY

Is made by the Planté process, no oxides being used, either mechanically or applied in the form of paste, paint or cement.

ELECTROMOTIVE FORCE HIGH; LIFE LONG.

Dry Batteries, Battery Supplies, etc. For further information address

AMERICAN BATTERY COMPANY,

Office: Rooms 23 and 24, 177 La Salle St., CHICAGO, ILL.

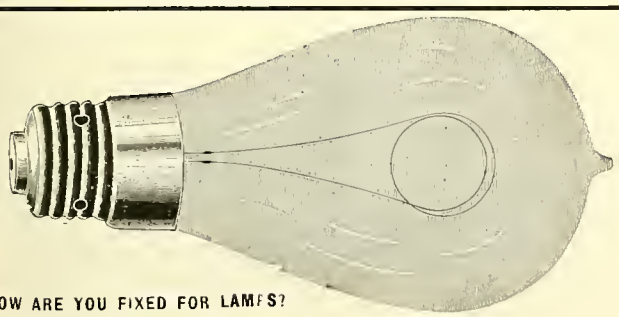
Send for Catalogue. **Send for Samples.**

Our Standing as Manufacturers of the Highest Grade of Hard Fibre is Unquestioned.

THE **DELAWARE HARD FIBRE COMPANY,**

WILMINGTON, DEL.

PARIS. BERLIN. BIRMINGHAM.



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We carry a stock at Chicago and can ship your orders direct from that point. Factory prices.

—THE—

"BUCKEYE"

SETS THE PACE.

THE BUCKEYE ELECTRIC CO., Cleveland, O.

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DAY'S KERITE

Day's Kerite.

Highest Grade of Insulation for

Electric Wires and Cables.

CUSHING & MORSE, General Western Agents,

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A NEW BOOK.

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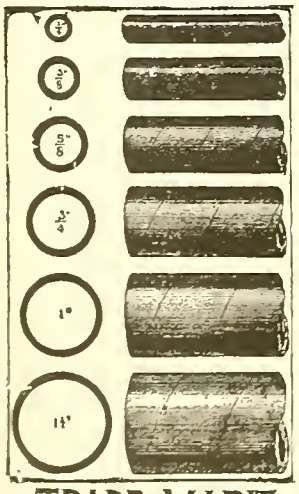

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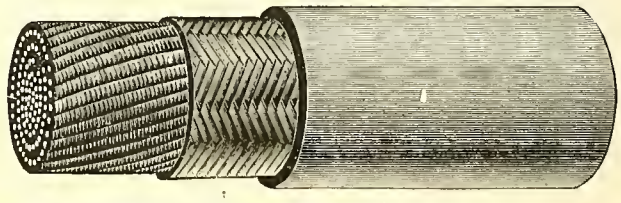

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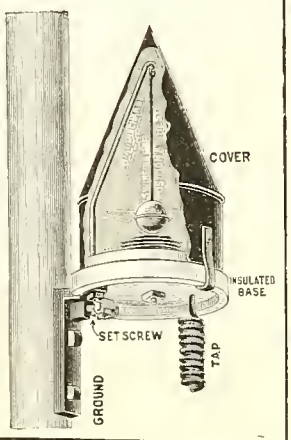

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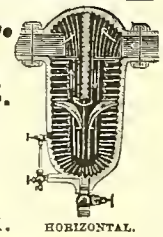
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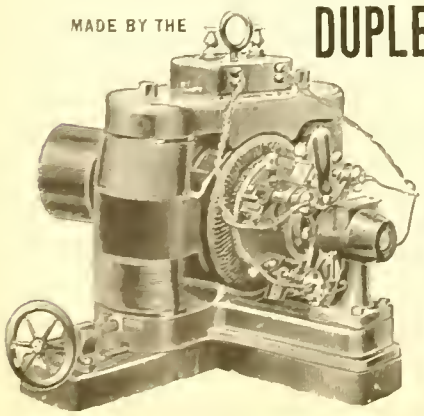

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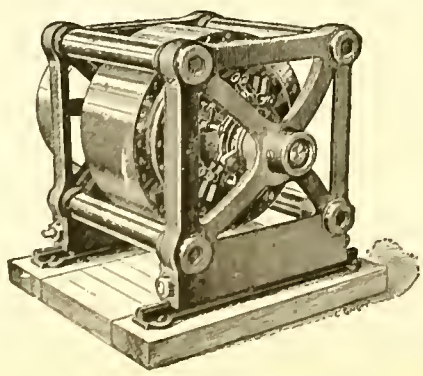

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Vol. XII. CHICAGO, APRIL 1, 1893. No 13

Electricity at the World's Fair.

Every exertion is being made to complete the Westinghouse incandescent installation at the World's Fair in time for the opening. Nearly all the parts for the big dynamos are now on the grounds, and the work of assembling the machines is proceeding rapidly. The illustration on this page shows the present stage of work on one of the two large alternators to be belted in tandem to the Allis 2,000 horse power engine. As will be seen, the bed-plate, pillar-blocks and half of the field-frames and magnet-windings are already in position. When the installation is completed these dynamos will extend about a foot and a half below the level of the flooring. The great engine that is to drive them is now being erected, nearly all the parts being in machinery hall. A train of eight cars was required to bring the parts from Milwaukee. One of the pieces weighs thirty tons, and special railroad tracks had to be laid in machinery hall to convey it to the site of the engine, the capacity of the traveling cranes being only twenty tons each. The frame of the two-storied Westinghouse switch-board is about completed. The temporary Westinghouse plant is now in operation. It consists of two Westinghouse 400 horse power engines belted to two 4,000 light alternators. These machines are a portion of the permanent plant and will undoubtedly remain in their present position until the close of the fair. Much annoyance has been caused by the leaky roof of machinery building, and the machines now in operation and a temporary switch-board have been sheltered in a "station" of wood and canvas. Connections have been made so that all the incandescent lamps now in use are supplied from this plant.

Nine of the sixteen Brush arc machines for the service plant are now in position in machinery hall, and some of them are being operated to relieve the arc dynamos in the old temporary station, which will soon be torn down. The striking switch-board for this plant is illustrated in Fig. 2. It is seven feet high and nine feet six inches wide, constructed, as can be clearly seen, for sixteen dynamos and sixteen exterior circuits. The board is of polished slate, with the switch connections plainly indicated by white porcelain letters and figures. The connections are all made by plug switches of peculiar construction, so arranged that when the switch is pulled from the socket the metallic portion is automatically covered by an insulating sheath, which is pushed back out of the way when the plug is re-inserted. Bus bars are arranged on the back of the board so that if it is desired to connect No. 1 dynamo with No. 16 circuit, for instance, it can be done by simply connecting the dynamo with one end of the bus bars and the desired circuit with the other, thus avoiding a long and inconvenient flexible connection across the face of the board. The switch-board is double, the rear portion containing the lightning arresters. Access is gained to the space between the front and rear portions by a plate glass door. No measuring instruments are placed on the switch-board, the ammeters being placed on stands near the dynamos. The plant will be driven by five Ball & Wood engines. It is being installed by J. R. Prentiss, assisted by F. L. Williams.

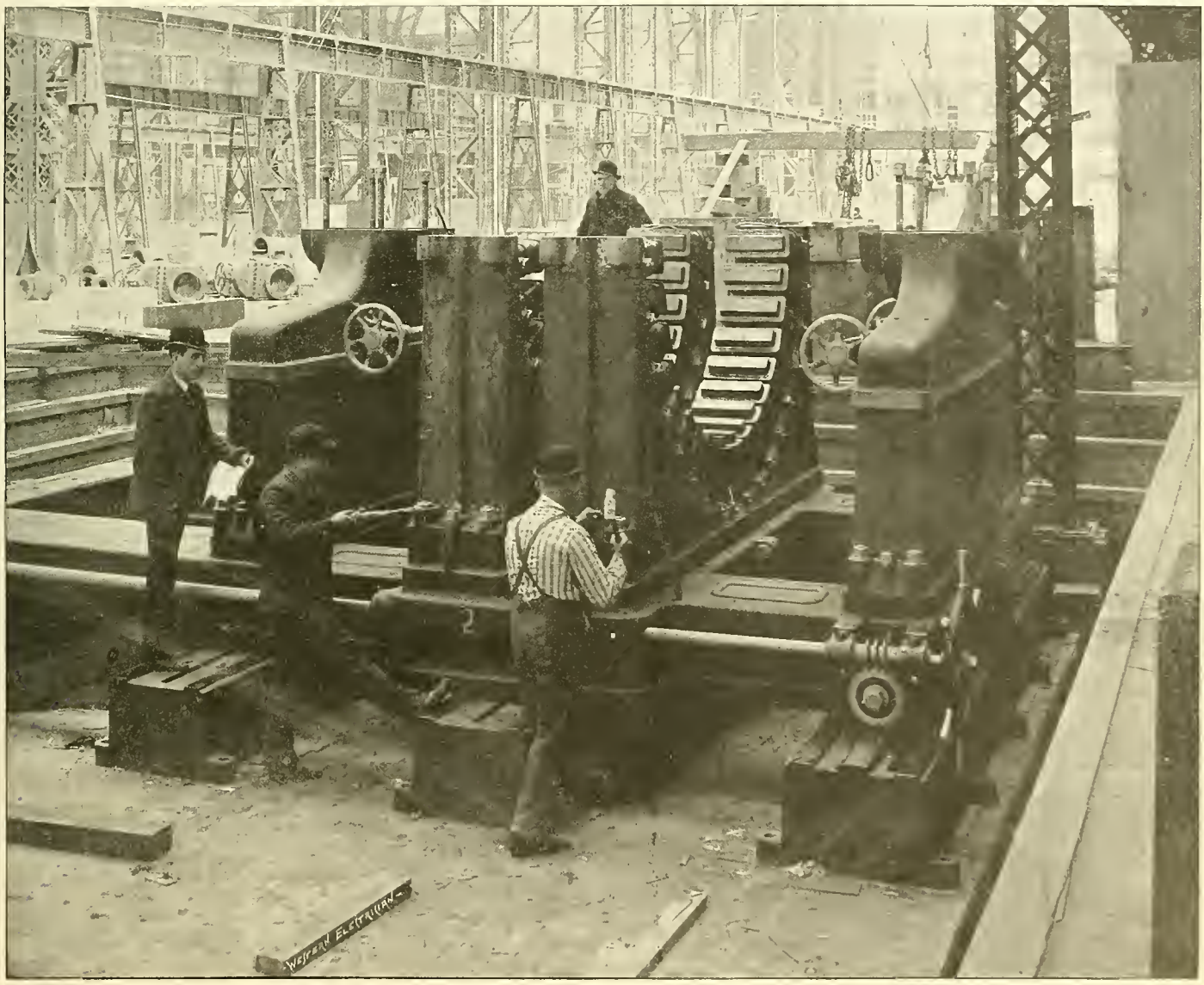


FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.

The Brush company's pavilion in the southwestern corner of electricity building is well under way. Some novel displays in this structure are promised. A complete section of Johnstone conduit has been placed in the northwestern portion of the building, on the ground floor.

Among the concessions recently granted was one to Otto S. Anschuetz for an electric scenic theater in Midway Plaisance and for the installation of fifty tachyscopes; also one to Turner Bottome for the sale of miniature incandescent lamps and other apparatus in electricity building.

"The magnificent building that will be devoted to electricity at the World's Fair should have special interest for

shoe and leather manufacturers," says *Hide and Leather*. "Electric lighting and power are gaining rapidly in popularity in our trade. Exhibitors of such appliances will no doubt be willing and ready to furnish desired information freely. In connection with this it might be an excellent plan for a certain time to be allotted for lectures or addresses on the advantages of the application of electricity for various manufacturing industries. Many who are not now acquainted with the wonders of electricity might be induced to change their minds if they listened to electrical experts. We trust that the valuable papers published in the interests of electricity will take up this matter and use their powerful influence on behalf of a series of industrial lectures on the subject mentioned."

The boiler plant at Jackson Park is now fired by oil. Two batteries of eight boilers have been operated for some time with this fuel with satisfactory results. No perceptible odor is emitted and the smoke nuisance is avoided. A recent issue of *Power* contained an interesting account of the oil fuel plant at Jackson Park. From it the following facts and the cut, Fig. 3, are taken:

The storage tanks, located in the extreme southeastern corner of the grounds, are each 8 feet in diameter by 25 feet long, built of 3-16 inch boiler iron. They are twelve in number, with a total capacity of 112,500 gallons. The vault in which they are placed is about 72 feet long by 68 feet wide, the outside walls being of brick varying from 32 inches thick at the bottom to 18 at the top. The vault is divided by 19 inch brick partitions into six compartments, two tanks being placed in each compartment. The capacity of each compartment is over twice that of the tanks which it contains, so that should a fire, explosion, or other accident take place in any section, notwithstanding the rapid expansion of the oil with heat, the danger would be confined to the section in which it originated. The walls of the vaults were carefully laid up in full joints of Portland cement mortar, the floor is of Portland cement concrete a foot thick, and the roof is constructed of steel I beams with brick arches. The vaults were placed as low in the ground as the water of the soil would permit, and the earth is banked solidly around and covers the top to the thickness of one foot.

The pumps and machinery for the transmission of the oil to the boilers were located as near as possible to the vaults. The arrangement of the machinery and piping was very carefully made, so as to insure a constant supply to the boilers under any emergency. After considerable negotiation a contract was entered into with the National Supply company of Chicago, for the storage tanks, standpipe, pumps and other machinery, as well as all piping required for the complete equipment of the plant.

In the regular operation of the oil plant the oil is delivered to the storage tanks from the main pipe line from the relay station at Whiting, Ind. (a distance of about 40 miles). The storage tanks will be filled once a day by a representative of the Standard Oil company. From the storage tanks the oil is pumped into a standpipe, 30 feet high and 30 inches diameter, which is connected directly to the boilers, thus maintaining a uniform pressure on the burners. When the oil is delivered in tank cars it will be necessary to pump it from these into storage tanks and thence into the standpipe. The storage tanks are carefully calibrated for the measurement of all oil delivered; and this is accomplished by measuring, each day before filling the tanks, the depth of oil in each one.

In the oil pump house, a small building located but a few feet east of the storage tank vaults, are placed the pumps and standpipe. Besides these also are two 40 horse power vertical boilers, 42 inches in diameter and 8 feet high, a small feed pump and a feed water heater, all for the operation of the plant. The oil pumps used are two duplex Snow pumps, each of a size sufficient for the work required at any one time. Each pump is arranged with a double suction connection, one from the storage tanks and one from the tank-car line, and also with a double discharge, to the standpipe and to the storage tanks. This is done so that either pump may be used independently to deliver oil to the boilers from the storage tanks or to fill the storage tanks from the cars. There is also a suction connection to the pumps from the main line between the standpipe and the boilers, this being put in so that should any serious accident occur at the boiler house end of the line the contents of the pipe can at once be pumped back into the storage tanks. The piping and valves are so arranged that either pump may be used for either service at any time. A by-pass is put in the delivery to the standpipe, and a quick opening valve with a connection into the overflow which runs from the standpipe to the storage tanks is put in, so that should an ignition or explosion take place in the standpipe its contents can be immediately emptied into the storage tanks. A single 5 inch wrought iron pipe connects the standpipe with the boiler house, and this is laid in an absolutely straight line about 3,200 feet long between the oil pump house and the center of the boiler house.

The oil pump house is equipped throughout with automatic electric valves, furnished by the National Electric Valve company of Cleveland. These valves are applied to the oil pumps, regulating the level in the standpipe; to the boiler feed pump, regulating the level of water in the boilers; and to the dampers of the boilers in the oil station, regulated by the steam pressure. By this arrangement any variation in demand for oil at the boiler house is, in theory at least, responded to automatically at the oil plant.

A 2 inch steam pipe is run parallel to the main pipe to the boiler house, and is laid in the same box with it. There is also a small steam coil of 1½ inch pipe placed in each storage tank. These pipes are necessary because, especially in cold weather, the oil is likely to become sluggish and very viscous, and is only liquefied by heat. The coils in the tanks are supplied with steam from the oil plant boilers, and the others will have a connection at each end, either of which may be used at will. At the boiler house the 5 inch oil supply pipe branches, running in both directions down the boiler house, the pipe being laid in a heavy wooden box covered throughout its length by removable cast iron plates. A branch is taken off the main line for each battery of boilers, and the burner connection is made from these branches.

Under the contracts for the boilers, each company has the right of selection of the burner to be used under its own make of boilers, the selection to be approved by the mechanical engineer of the exposition. As yet it is not decided what burners are to be used under all of the boilers. The Reed burners will be put on all of the Root and National boilers, and on two of the eight Heine, the Armstrong burner on all of the four Gill (Stearns Manufacturing company) boilers, the International on at least two of the Heine boilers. The Hydro-Carbon company's burner will probably be also represented. The burners, however, for the Campbell & Zell and the Babcock & Wilcox boilers are not as yet determined upon.

The burners will be set in various ways, and the construction of the furnaces, while in most cases on the same general principle, will vary in detail. On the National and Gill boilers the burners are placed inside the fire door, and all piping and connections are behind the boiler fronts, so that when the doors are closed, nothing is visible from the fire room. The furnaces are so made that the air coming from the ash door openings passes to the rear of the furnaces, then through a horizontal passage to the front, where it comes in contact with the oil spray, becoming heated to a high degree before combustion takes place. In the National boilers the return passage is made up of flues made of fire brick laid on edge, and which become almost white hot; and the furnace is made very deep and with a concave arch at the rear. The burner is inclined slightly downward so that the flame is directed well into the arch and the heat reflected back and thus distributed as evenly as possible over the surface of the boiler tubes above. This construction is somewhat novel, and is a recent design of the National Supply company.

In order to make the steam connections to the burners, a header of two-inch pipe is run over each battery of boilers, and the burner connections are taken off from these. These headers are provided with separate 1½ inch connections to the boilers, independent of the main steam connections; and the headers over each battery are cross connected by a 2½ inch pipe which runs the entire length of the boiler room, so that, if any boilers have been shut down, they may be started up from any other boiler in the plant.

The Ausonia Electric company of Chicago has established a World's Fair bureau for the benefit and convenience of its customers residing outside of Chicago. The department has been placed in charge of Hon. George B. Shaw, who was lately elected to Congress from the Eau Claire, Wis., district, and who is well known to electrical men through his connection with the National Electric Manufacturing company.

St. Louis Electrical Exchange.

The St. Louis Electrical Exchange, which was organized about eighteen months ago, has been incorporated under the laws of Missouri. It was organized for the purpose of bringing together in closer business relations the various electrical construction companies of the city, and also to further the general interests of the trade. The membership is composed of construction firms, supply houses and electric light and power companies, and at present about thirty firms are represented. The exchange meets twice a month in the evening, when topics of interest to the members are discussed. The exchange is working in harmony with the board of underwriters, lighting companies and the city electrician, and is now taking steps to pass such city regulations as will protect and further its business. The exchange has had a good influence on the trade, as none but responsible firms are admitted to membership. The officers for the ensuing year are: President, Edward T. Cooke; vice-president, J. Masson; secretary, Otto Kuhn; treasurer, J. Holdsworth; sergeant-at-arms, G. Brownlee. The secretary, Otto Kuhn, 807 Market street, St. Louis, will be pleased to hear from some of the leading construction firms throughout the country with the view of having exchanges organized in other cities, which would ultimately lead to forming a national organization of electrical construction firms. On application the secretary will mail a copy of the constitution and by-laws and give such other information as may be of value in forming exchanges.

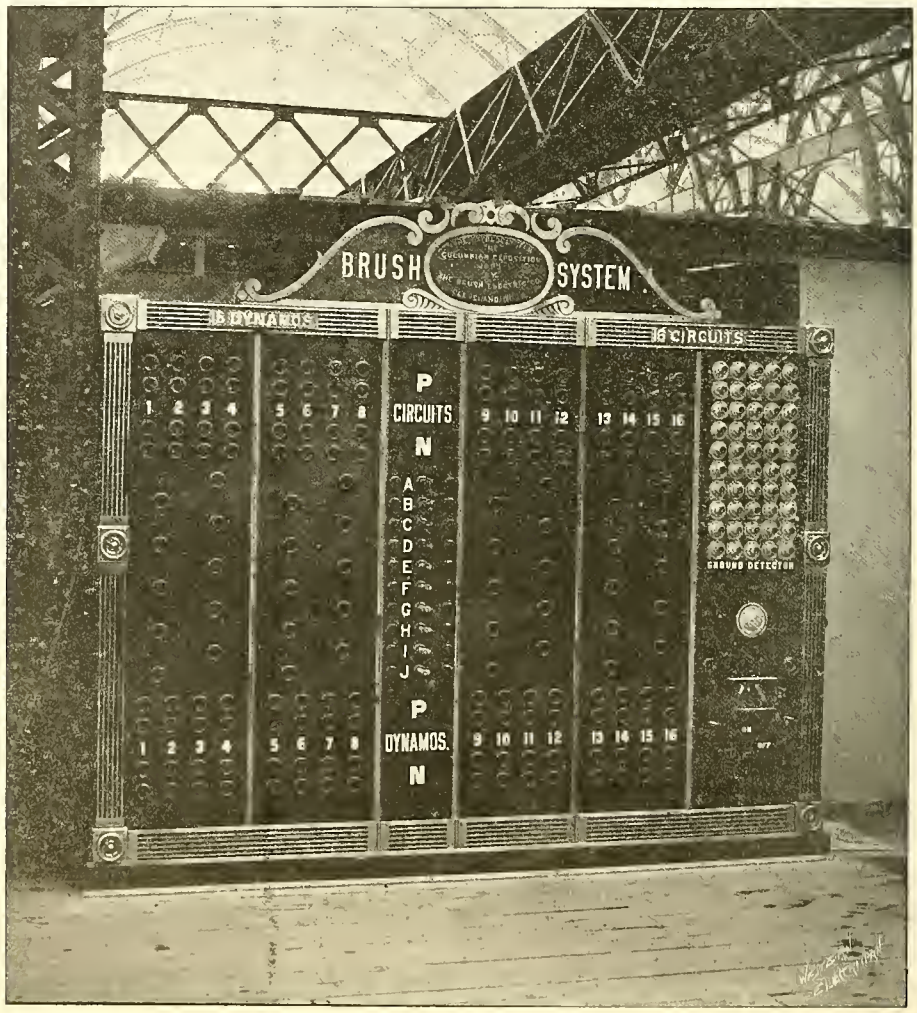


FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.

There are at present 1,850 cities and towns in the United States equipped with electric lights. It is interesting to note that Pennsylvania takes the lead with 150 towns, New York and Illinois following with 147 and 133 respectively, and that in the first state there are no less than thirty-two new lighting corporations which have not yet commenced business. There are over 500 railways operated by electricity in the country, and 200 more incorporated holding franchises allowing the use of electric power.

Electric Motors in Breakwater Construction.

In the WESTERN ELECTRICIAN of October 15th last was presented an illustrated description of the electric traveling cranes used in the construction of the breakwater at the port of Bilboa in Spain. This structure is built of huge blocks of artificial stone on a natural foundation, which crops out above the surface of the water at low tide. In the construction blocks are first laid, forming a base 39 feet in width, 23 feet above low water and seven feet four inches above high water. Above this is built a wall 13 feet in width and 10 feet in height. This is surmounted by a parapet 10 feet in width and three feet three inches in height. This massive construction was rendered necessary by the extreme violence of the sea at this point, which has threatened more than once to overwhelm the workmen during the progress of the work.

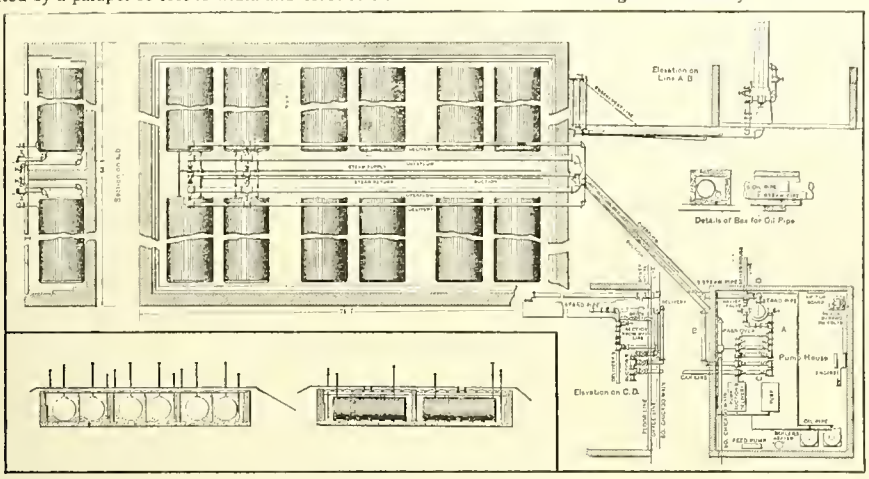


FIG. 3. ELECTRICITY AT THE WORLD'S FAIR.

The blocks are made in two sizes, the larger molds containing 60 cubic yards. The huge blocks of cement are carried by special forms of traveling cranes to flat-boats, whence they are towed to the point where building is in progress. The apparatus used in this part of the work was described and illustrated in the issue referred to. In the accompanying illustration is represented the apparatus which is used in the construction. The work has been especially expedited by the construction of the traveling steel framework, or "titan," as it is called, shown in the cut, extending out beyond the completed portion of the breakwater. This ponderous structure is 100 feet in length and is mounted on wheels running on rails laid on the breakwater. It can be moved so that it will project 65 feet beyond the finished masonry, as the rear portion is rendered much the heavier by counterweights. Power for moving the "titan" is furnished by an electric motor, which takes current from a dynamo which is located some little distance away. This machine is driven by a 40 horse power engine. The current is carried by a bare copper wire, which is shown rather prominently at the left in the illustration.

On top of the "titan" runs a traveling crane, which is also electrically operated. This carries the blocks of stone to the point where they are to be placed. In the cabin at the back of the "titan" is a motor which is used for a variety of purposes. It operates a pump, draws the tram cars filled with sand and crushed stone up the inclined plane as shown in the engraving and furnishes power for a cement mixer. The cement thus prepared on the spot is dumped to the place where it is needed through a chute. The cut is reproduced from *La Nature*.

Electric Circuit of St. Louis.

The Electric Circuit of St. Louis has secured rooms in the Bowman building, Eleventh and Locust streets. The organization had its first lecture Thursday night, March 23d, on the "Underlying Principles of Electricity." Prof. G. W. Krall of the Manual Training School was the speaker of the evening. The next lecture will be given on April 27th by H. A. Wagner, electrician for the Missouri Electric Light & Power company, on the "Alternating Current Transformer." The club accepted a number of new members at the last meeting.

The trolley war which was waged in Beverly, Mass., for three years is ended. At a conference between the selectmen and Manager Foster of the Lynn & Boston Street Railway company it was agreed that the trolley system should be extended to Beverly under the same conditions imposed in Salem. The company will commence operations as soon as the ground is open, and will lay new rails throughout. It expects to spend $100,000 in Beverly this year.

Present Status of the Storage Battery.[1]

BY J. K. PUMPELLY AND C. SORLEY.

In order to put before you in a concise form the status of the storage battery at this date, it is necessary to go somewhat into its history. Plante in 1860 published the fact that he had discovered a method of storing electricity by using certain metals immersed in certain solutions, and that he had obtained the best results from sheet lead immersed in dilute sulphuric acid and subjected to a long process of alternately charging, discharging, and reversing for the purpose of forming a layer of active material upon the surface of the sheet lead; but unfortunately this process of forming the active material was very costly, owing to the great length of time required.

In 1881 Faure brought out a battery in which he used the same material, namely, lead and dilute sulphuric acid, but instead of making the active material out of the plate itself, as Plante did, he applied an active material or material to become active to the plates, in the form of a paste, paint or cement. This was a great advance so far as cost of production was concerned, but not when viewed from other standpoints, as it introduced some very serious defects, the greatest of which was the liability of the active material to scale off, or in other words to become detached from the plates. This would not only cause loss of capacity, due to loss of active material, but these scales were liable to lodge between the plates and short circuit the battery. The aim, therefore of all makers of storage batteries since the Faure battery came out has been to so construct a battery that it should be impossible for the active material to fall off the plates. This has been accomplished in various ways, but almost invariably the result has been the introduction of another serious defect, namely, greater internal resistance and therefore less efficiency, for if the internal resistance is increased it will necessarily take a greater electromotive force to put a given quantity of current through the battery, while in discharging this internal resistance will be added to the external resistance of the circuit, and cause a corresponding loss in the discharge.

One of the greatest stumbling blocks in the way of inventors who have tried to find a means of keeping the active material from falling off the plates has been the universally accepted idea that it is absolutely necessary to have a free circulation of the solution. After a long series of experiments we have found that this is not necessary, providing a porous and also absorbent substance (capable of absorbing the sulphuric acid as fast as it is made in charging) has been placed between the plates.

This is a very important discovery, for it not only makes it impossible for the active material to fall off or out of the plates, but it enables us to jam the plates up close together and so make one solid compact mass of the element, without any free solution to spill over everything when the battery is used for traction and other analogous purposes, and it also adds a number of years to the life of the battery, for, when the positive plates would not be able to support their own weight if made in the old way, where every plate stands alone, by this method the negative plates will support them, and it also enables us to lower the internal resistance by bringing the positive and negative plates so much closer together.

We have also found that no matter how well a battery may be constructed it is not possible to get as good results from one constructed upon the Faure principle (that is to say, with a mechanically applied oxide) as can be obtained from one made on the Plante principle. This brings us down to the question, can a Plante battery be made commercially successful, that is to say, can the electro-chemical process of forming the active materials out of the plates itself be shortened from several months to a few days or hours?

We are glad to be able to answer that question in the affirmative. By a process discovered by Mr. Sorley, after seven months of costly experimenting by Mr. Sorley and myself, we have succeeded in developing a Plante battery in which the active material is made electro-chemically in one hour and fifty minutes. We are glad to produce before you one of the batteries containing all the latest improvements as I have described them.

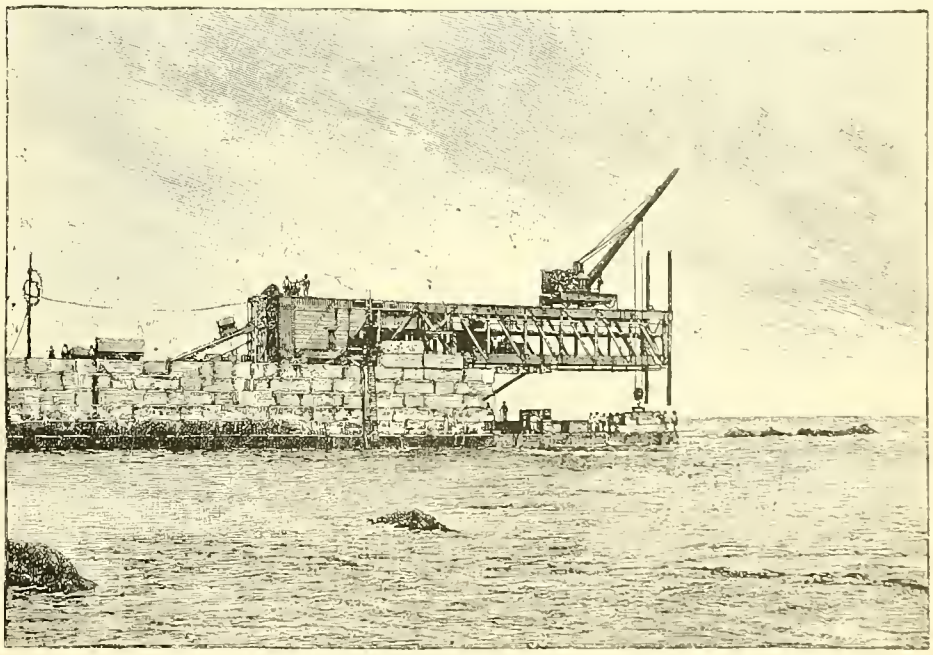
It has been said that storage batteries will never do for street car work, owing to the fact that when a car is climbing a heavy grade the demand on the battery for current is so great that it will not maintain its electromotive force, and that consequently when you exceed a certain number of amperes the voltage falls in proportion and you do not get any more watts, or in other words, although you are discharging the battery at a greater rate you do not get any more energy. Now this is true to a certain extent of a battery made with a mechanically-applied oxide, but not one where the active material is electro-chemically made, as Mr. Sorley will illustrate to you with the battery before you, which contains an element that only measures 6x6x 6½ inches, but which has a capacity of 177.7 ampere hours, discharging at a rate of 23 amperes. He will show you that it is possible to discharge it as high as 75 to 85 amperes for, say, twenty minutes, which is ample time to climb a grade, and that this discharge of, say, 80 amperes for twenty minutes will not lower the voltage more than 5-100 of a volt; that is to say, the electromotive force during this large discharge from so small a cell will remain constant at 1.95 volts.

Now this electromotive force, with the usual number of cells that are placed in a street car series, would produce at the terminals of the motor, at the discharge rate of 80 amperes, nearly 21 horse power, or accurately, 20.9 horse power.

Allowing that the test is to a great extent convincing to you, you will naturally ask, how do you know that this form of Plante battery will be any more durable, or that the plates will remain firm and intact any longer than the pasted or mechanically applied oxide plate?

In answering such a question, we have to judge by our experience and our knowledge of the chemical action on the plates. The constant tendency of this chemical action on the pasted plate is that of slow disintegration, caused largely, in our opinion, by the impurities that are introduced into the plate in the oxides of lead which are mechanically

1. Paper read before the Chicago Electric club, March 20, 1893, by Mr. Pumpelly; tests conducted by Mr. Sorley.



ELECTRIC MOTORS IN BREAKWATER CONSTRUCTION.

applied, whereas all the impurities which may be in the lead plate itself are dissolved out and remain in the first solution, and consequently the peroxide and spongy lead that are subseqently formed are made out of perfectly pure lead, and there is no longer any chance of disintegration arising from local action. While on the subject of rolled lead, it would be proper to mention that the plates in this cell before you are made from one integral sheet of lead 3/8 of an inch thick and prepared for treatment by a new method patented by us, which does away with all joints or soldering, thus avoiding any chance for local action. Aside from this, the process greatly cheapens the cost of making the plate.

One fact we have learned to aid us to a further conclusion, and that is, that when pure rolled lead such as this battery is made of, is used for the electrodes, the plates are far more durable than when constructed of cast lead, even when the active material is mechanically applied, and we know of plates so constructed that have lasted for five years. In conclusion, we wish to say that for lighting purposes where weight is not an objection there is no reason why a storage battery should not be made that would last for twenty years, and this being the case, there is no reason why storage batteries should not take the place in electrical work that the gasometer now takes in gas engineering, that is, act as a reservoir from which to distribute current from central stations.

Thomas G. Grier and B. J. Arnold made a test of the battery exhibited by Messrs. Pumpelly and Sorley during the discussion which followed the reading of the paper. At the close of the discussion the report of this test was submitted by Mr. Arnold as follows:

We took these readings at intervals of two minutes, beginning at 8:58 P. M., and ending at 9:18, a twenty minutes' run as suggested. The voltage began at 1.94. The first reading is 94 amperes at 1 94 volts; the next, 93½ amperes, 1.94; then 93 amperes, 1.93—a slight drop in voltage. The next is 92½ amperes, 1.92; the next 92½ amperes and 1.91 volts; the next 92 amperes and 1.91; the next 92 amperes, 1.91; the next 91⅞ amperes, 1.90; the next 91⅞ and 1.90; the next 91¾ amperes and 1.88; the next 91½ and 1.86, which was the last reading. The mean of all these readings is 92.4 amperes and 1.91 volts, making an average output of 176.5 watts or .237 horse power, or practically a quarter of a horse power in each cell. For the 100 cells it would be 23.7 horse power, or practically 24 horse power, which is somewhat in excess of what the paper claimed. The paper claimed 20.9, and we got 23.7, over two additional horse power.

At the conclusion of this report a wire was placed across the terminals of the battery, short-circuiting it and melting the wire. This was immediately repeated, the battery still being able to perform its work, and showing at the conclusion of the test a voltage of 2.2 without load.

Freaks of Lightning.

On March 15th there was a severe electrical storm along the Atlantic coast. Press dispatches from Massachusetts, New Jersey, New York and Rhode Island report considerable damage. At North Middleboro, Mass., the Congregational church was struck by lightning and destroyed. At Woonsocket, R. I., the lightning set fire to 110 bales of cotton, which were destroyed. All the telegraph wires between Springfield, Mass., and New York were useless. At many other points damage to houses and other property is reported.

Edwin Satterthwaite, a farmer, his wife and son Henry were struck by lightning at Bordentown, N. J. Henry was knocked off a wagon and was found insensible in the road. His hands, arms, back and head were covered with red streaks. His mother and father were knocked senseless while at supper. All three were dangerously hurt, but will recover.

Lightning struck the Stonington line steamer New Hampshire on her trip from New York to Stonington on March 14th. Fifteen of the saloon windows were blown to pieces and glass in other parts of the boat was shattered. A bunch of electric lights suspended on the rear deck was demolished and the sheathing around the deck covering torn off and scattered about the deck.

Van Rysselberghe Hydro-electric Installation in Antwerp.

The choice of a system for distributing electrical energy is dependent, generally speaking, upon local conditions. If the area to be served is compact, a low tension, direct current system is likely to be selected. If the consumers are

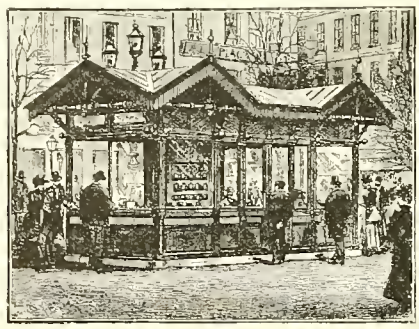


FIG. 2. VAN RYSSELBERGHE HYDRO-ELECTRIC INSTALLATION IN ANTWERP.

scattered over a considerable territory, a high tension, alternating system may be adopted. Continuous current transformers or batteries of accumulators may also be employed in the same case. But with the former the efficiency is less than when high tension alternating currents are transformed by converters, and sub-stations requiring attention are necessary. The advantages attending the use

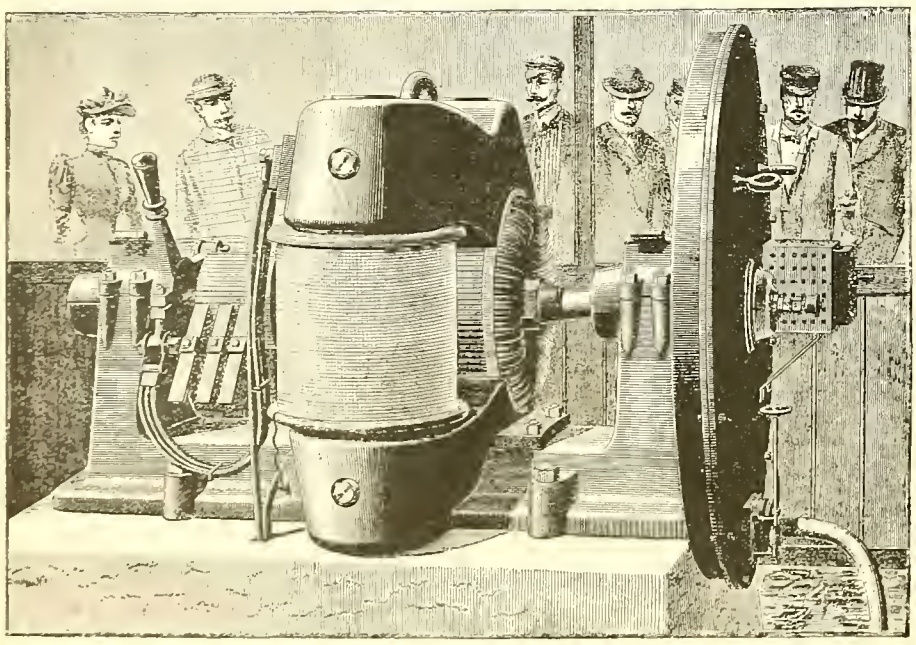


FIG. 1. VAN RYSSELBERGHE HYDRO-ELECTRIC INSTALLATION IN ANTWERP.

of accumulators are obvious, but their efficiency is not high and their depreciation is rapid.

There are notorious disadvantages connected with distributing power by non electrical systems. Compressed air, for example, is an exceedingly poor agent from the point of efficiency, and the gas engine used for transforming latent thermic energy is a complicated and delicate piece of apparatus less convenient and more cumbrous than the electric motor. When gas and compressed air are used the substation becomes a veritable power plant comprising complex apparatus and considerable labor.

"The transmission of energy by means of water under pressure is an intermediate system, the adabtability and simplicity of which we had the opportunity to observe recently in visiting the Van Rysselberghe hydro-electric installation at Antwerp," says E. Hospitalier in *La Nature*. "Van Rysselberghe's system is designed to transmit power by water under pressure and to use it in that form for power where it is needed and to establish substations for generating electricity for public and private lighting in the principal centers of consumption."

The city of Antwerp offered to Van Rysselberghe exceptionally favorable conditions for making a trial of his hydro-electric distributing scheme, and it must be admitted that he has magnified its merits and minimized its disadvantages. For many years the city has possessed an hydraulic station for distributing water under pressure for operating the cranes used on the harbor docks. This water is furnished at a pressure of 50 kilogrammes per square centimeter or about 50 atmospheres. Each cubic meter of water therefore represents a gross energy of 500,000 kilogramme-meters and will furnish 800 watts taking into account the efficiency of the hydraulic motor or turbine utilizing the pressure. The water under this pressure is distributed by means of hydraulic pumps throughout the city, and besides driving the hydraulic motors will operate a number of sub-stations similiar to that now installed in Place Verte, illustrated in the cuts. Fig. 1 gives a view of the generator and Fig. 2 represents the handsome little structure in which it is installed. The apparatus comprises a turbine wheel whose shaft is coupled to a continuous current dynamo. The admission of water is varied in accordance with the load on the machine. The attendant watches the ammeter and voltmeter and controls the operation of the machine by admitting water into the turbine or shutting it off, and by working the rheostat which controls the exciting of the field coils.

The simplicity of the installation is attractive and its success has been demonstrated to the extent of inducing capitalists to subscribe the money necessary to enable the inventor to execute his project.

"We confess," Mr. Hospitalier continues, "that we are less convinced than the capitalists. The system does not appear to be destined to as great a success as the promoters expected. Distribution of current at 500 volts is easily effected to-day. The efficiency of the hydraulic motor is less than that of electric motors, and the efficiency of the turbines, which can only be conjectured, is, according to the optimistic estimate of Van Rysselberghe, only 70 per cent. It seems that he has taken a step backward by resorting to hydraulic transmission and electric distribution. We would prefer to transmit at a potential of 500 or 600 volts, which would be sufficient to reach economically the most distant points in the system. We would then have a single system instead of two—one hydraulic for large power units and sub-stations, the other electrical for lighting and small motors.

"The conditions will be entirely different if it is proposed to utilize a station for distributing water under pressure, installed for other purposes, the power of which is greater than the requirements of consumers. In this case the hydro-electric combination will enlarge the field of usefulness of the plant without increasing correspondingly the expenses of the installation. This, however, is not the situation at Antwerp, as it is proposed to construct a special station for the simple purpose of producing water pressure. On this point we are far from sharing the opinion of the Belgian inventor."

Telephonic Communication Without a Special Line.[1]

By G. Mareschal.

I have noticed that if I attach one wire to a gas pipe and another to a water pipe and connect the two to a telephone, the existence of a current will be proved by the sound in the instrument upon opening and closing the circuit. To measure it I have substituted a galvanometer for the telephone and as nearly as I have been able to determine with the primitive apparatus at my disposal, the deviation corresponds to a quarter of a volt. What is especially remarkable about the current is its continuity. The needle of the galvanometer has remained almost stationary for a year, varying one or two degrees to the right or the left during the course of each day.

It was my first impression that I had proved the existence of an earth current, but in view of its continuity I came to the conclusion that the action was rather that of a battery of which the water and gas pipes formed the elements which were attacked by the media in which they were located. The positive pole is the water pipe and the negative the gas pipe. I have repeated the experiment with success in many houses in Paris and elsewhere; but no current was found in places where the pipes were in close contact.

At my own home the current disappeared for about two months in consequence of the introduction of gas pipes in a certain room. It is likely that the workmen unwittingly established a contact between the two pipes. The experiment is an interesting one to make and all those who have a common galvanometer, or better yet, a telephone, can investigate the existence of the current.

But can the current be utilized? The current strength is so small that perhaps it is not likely. However, it would be easy to design some little motor that would revolve indefinitely and this movement might be utilized perhaps by a skillful mechanic for operating a tiny clock.

It is a sequence of this experiment that the pipes are relatively insulated most of the time, and I wondered if they could not be used as the two wires for telephonic com-

1. Abstract of an article in *La Nature*.

munication. As a matter of fact I have been able to talk with a friend living six doors away, using the pipes as conductors. The experiment was conducted in a very simple fashion. In my own room were placed three bichromate cells and in the circuit was connected a microphone without the induction coil; in the neighboring house was arranged the telephone connected to the two pipes. An article from a daily paper read in my room was heard perfectly in the house of my friend. We then elaborated the experimeot. The microphone was placed behind the piano and music was heard in several houses on the same street and on a neighboring street.

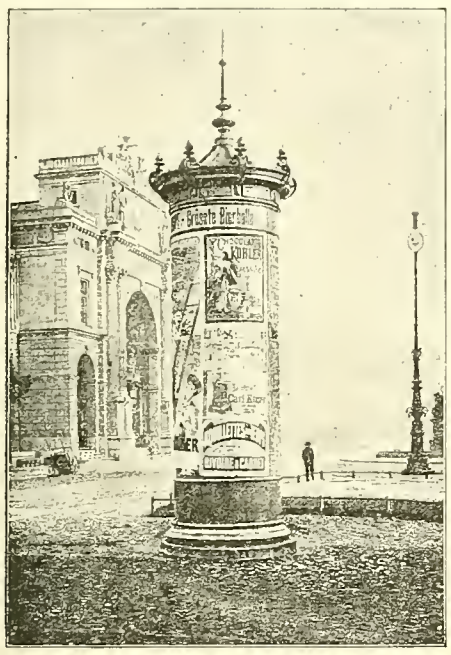


FIG. 2. MUNICIPAL ELECTRIC LIGHT PLANT AT ZURICH, SWITZERLAND.

Municipal Electric Light Plant at Zurich, Switzerland.

The principle of the municipal control of city illumination has taken firm hold in the most important Swiss cities, as it has in the German municipalities. It has been the general policy to acquire existing gas works and electric light stations. In Zurich the local authorities have persistently refused to great electric light franchises, as they had determined some years ago to build a city plant. Had a different course been pursued the citizens would certainly have been provided with electric light at a much earlier date. In 1887 the project for lighting the city by electricity was brought forward for consideration, and an investigation was begun. Two years later the enterprise had reached the stage where the city engineer was able to make a report, and the following year manufacturing companies were asked to present bids in accordance with the adopted plans. A commission was then appointed to determine the apparatus to be used, and a decision in favor of the alternating current system of the Oerlikon Works was finally reached. In December last the plant was for the first time in complete operation, although the plans for the entire installation have by no means been executed even at the present time. Just half of the machinery provided for by the plans is now in place.

The electric light plant has been installed as an annex to the pumping station, which for years has been in operation. It was planned to make use of the water power from the River Limmat. A raceway three-quarters of a mile in length leading to the station was built twenty years ago. Extending the entire length of the station in which the dynamos and pumps are located is a main shaft, which is cut in two places and joined by clutch couplings. This is ordinarily driven by eight turbines, ranging in capacity from 100 horse power to 150 horse power, which had been furnishing power for the pumps. As a reserve power two new high pressure turbines of 175 horse power each and a compound condensing engine of 225 horse power have been introduced. The water for the former is taken from a high reservoir, to which it is pumped during the day before the heavy load for lighting comes on the station. The power stored is equivalent to at least 3,000 horse power hours.

The two dynamos at present in operation, Fig. 1, are Oerlikon alternators of 200 kilowatts capacity each (100 amperes and 2,000 volts). The current is carried in a main consisting of three concentric cables to a distributing station 7,100 feet distant, with a loss of 5 per cent. Thence the current is carried in tile conduits to eight transformer stations, where the potential is reduced to 100 volts in the secondary wires. The general appearance of these structures is shown in Fig. 2. The municipality ought to derive quite a revenue from them by the sale of advertising space. In these stations there are now installed sixteen transformers, sufficient to supply 5,000 lamps.

A number of alternating current arc lamps are used for street lighting. They are connected in series of five. The lamp used is that of the Siemens type, which takes 18 amperes. The style of ornamental post used is shown in Fig. 3.

In connection with the system several alternating current motors made at the Oerlikon Works are operated. One of these drives the press of the *Buender Zeitung*. The illustrations presented herewith are reproduced from *L'Electricien*.

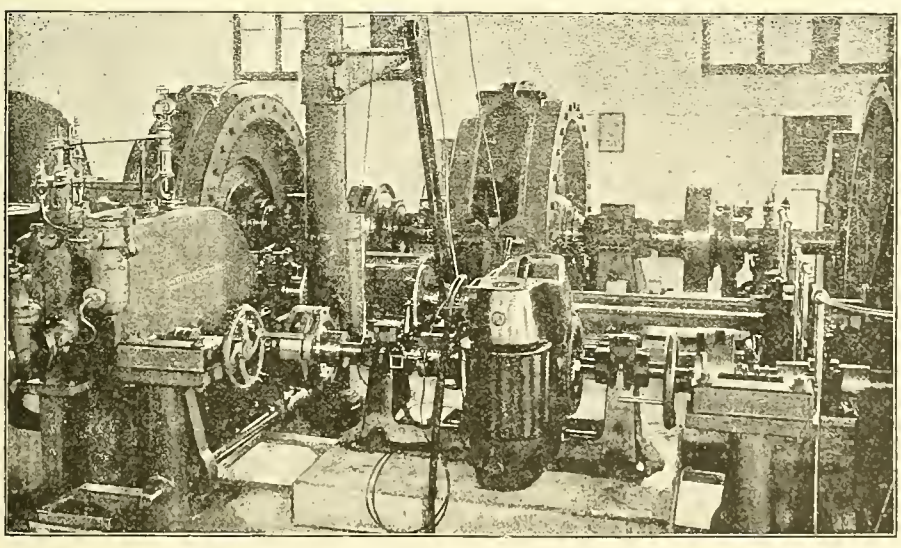


FIG. 1. MUNICIPAL ELECTRIC LIGHT PLANT AT ZURICH, SWITZERLAND.

Telephone and Telegraph Wires Down.

The wires of the Long Distance Telephone, Western Union and Postal Telegraph companies, between Chicago and Milwaukee, were subjected to a severe storm last week. On Thursday and Friday, March 22d and 23d, a terrific snow, sleet and rain storm played havoc with the wires, and nearly all the poles between Western Union Junction and Milwaukee—a distance of nearly four miles—were blown down. The Long Distance company detailed seventy linemen from Chicago to repair the damage, and the service was but slightly affected.

Judge Prentice of Hartford, Conn., filed his decision in the case of F. Thills' Sons & Co. against the Perkins Electric Lamp company in the Superior Court March 16th. Judgment for the plaintiffs for $1,529 74 was given. The plaintiffs, a New York concern, claimed that the defendant company purchased goods valued at $1,350 prior to June, 1891, and refused to pay for them. Damages of $2,000 were claimed. The Perkins company claimed that the goods were defective, and that their business was damaged thereby. A counter claim for $70,000 damages was instituted.

Electric Motors Operating on Single Phase Alternating Current Circuits.

By Elias E. Ries and Gordon J. Scott.

In view of the discussion that has recently taken place in reference to alternating current motors, both in this country and Europe we desire to announce that for the last year and a half, we have given a great deal of attention to the question of power transmission by the use of the commercial alternating currents now in use. The subject has been dealt with on circuits, the frequency of which varied all the way from 200 to 40 cycles per second. Some very interesting and useful facts have come to light, and our experiments have shown that practical alternating current motors of any size can be built and and operated at the ordinary frequency of 138 cycles per second, or even at higher frequencies, with a commercial efficiency equal to any direct current motor.

This has been fully demonstrated by experiments made upon a motor in the factory of the Ries Electric Specialty company, which develops nearly two horse power at the slow speed of 360 revolutions per minute. The total weight of this motor is just 64 pounds. There are only two pounds of copper on the machine, and it shows a commercial efficiency of 85 per cent. when run upon an ordinary incandescent lighting circuit of 50 volts, at a frequency of 138 cycles per second.

The motor referred to is built upon entirely new lines and is radically different from any of the types of alternating motors thus far described. The motor operates without the use of condensers, reaction devices, secondary batteries, or similar paraphernalia for changing the lag or phase. We intend to turn out in a short time, in addition to this type, an entirely new single phase motor of high efficiency, having a completly closed magnetic circuit, and as a consequence a very small magnetizing force.

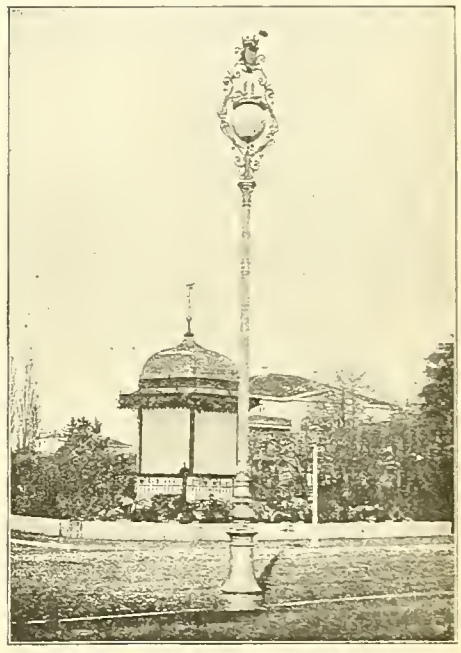


FIG. 3. MUNICIPAL ELECTRIC LIGHT PLANT AT ZURICH, SWITZERLAND.

For electric railway work we have a special form of this motor under way, which will have a variable speed with maximum torque, a feature that has not heretofore been possible either with direct or alternating current motors, although numerous attempts have been made by inventors to produce this desirable result in direct current practice, by the use of motor generators, differential gearing and other equally complicated devices. The Ries and Scott railway motor of this type will be of 20 horse power and will weigh when completed about 600 pounds, which is less than one-half of the weight of direct current railway motors, thus combining great starting effort with low consumption of energy and with very light weight. This motor will not only solve the difficulty that has thus far been encountered in utilizing single phase alternating currents for operating stationary motors of all powers, but will also render it commercially possible to employ the alternating current for electric railway work, on a scale that will render the system, for economy in transmission and regulation, to say nothing of increased safety and freedom from repairs, far superior to the direct current electric railway practice of to-day.

Tama, Ia., is to have an electric street railway.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE *Lancet*, the widely known English medical journal, in discussing the urgent need of congenial employment for blind people, suggests that they might well be employed as telephone operators. The idea seems to be a good one and worthy of a trial. It is said that blindness sharpens the hearing as well as the other remaining senses, and there seems to be no insuperable objection to the employment of blind girls in a telephone exchange. It would be interesting to note the results of such an experiment, and we hope that some American telephone manager with humanity and enterprise will try it.

GRADUALLY Chicago is being surrounded by a network of electric railways, and it is stated that electric railway companies now operate or are constructing 115 miles of track in Chicago or its immediate environs. The north, west and south suburbs are rapidly coming to look upon the once despised overhead trolley as their only hope of rapid transit, and no doubt it will soon be possible to make a complete circuit of the city in electric cars. This encouraging outlook is largely due to the demand for increased facilities caused by the World's Fair, but there can be no doubt that the system will be gradually extended as soon as the people come to appreciate its advantages by experience. No doubt it will be a long time before the trolley is introduced in the crowded down-town business streets, if ever, but there is no reason why the electric system should not replace the horse cars on cross-town and auxiliary lines throughout the city.

THE paper on storage batteries by Messrs. Pumpelly and Sorley, before the Chicago Electric club, which is presented in this issue, is worthy the consideration of everybody interested in this particular line. At the present time, when there is so much expected of the storage battery and so little real advancement has been made, a free discussion of this topic, and everything that may tend to advance the work, should be encouraged. Storage batteries have not had a fair trial in this country, but the fault has been with the companies exploiting them rather than with the public. It is remarkable that with all the disappointments and failures in this line, the people cling to the belief that there will be an efficient, durable and comparatively economical battery eventually developed. Surely such faith should not go unrewarded.

RUMORS of trouble between the Western Union Telegraph company and its operators are industriously disseminated by the New York papers and as vigorously denied by the officials of the company. A great telegraph strike during the World's Fair would be a national calamity, and it is a pleasure to observe that many of the leading members of the Order of Commercial Telegraphers assert that a strike at such a time will not be countenanced by their organization. It is to be hoped that these gentlemen correctly represent the temper of their order and that, if dissatisfaction exists, every effort to adjust the difficulty will be exerted by both sides before the public is put to the untold inconvenience that a strike would cause. The people will have something to say in this matter, and if telegraphic communication is seriously interrupted, especially at this time, those who bring about the conflict will surely have cause to regret their action.

IF all the exhibits for the World's Fair were in the advanced stage of completion and installation of those intended for the electricity building, there would be no question of the completion of preparations by May 1st. To quote Mr. Hornsby's words: "We will be perfectly ready for the opening. Everything will be in by April 10th, and we have the assurance of all the exhibitors that their workmen will be through and out of the way by April 20th. This is not surprising for three reasons: This was the first department to organize; the electrical people know better than almost anybody else how to make an exhibit; and numerically the department is the smallest in the whole list." This is a matter for congratulation all around, and Prof. Barrett, Mr. Hornsby and their assistants are entitled to especial thanks. That the electrical department should lead all the rest shows the soundness of the judgment of the exposition management in according electricity the prominent position it occupies at the World's Fair.

IN Minnesota a commendable reform measure has been introduced in the Legislature and bids fair to become a law. It is a bill requiring electric railway companies in that state to inclose the front platforms of their cars during certain portions of the year. The bill provides that during the months of January, February, March and December the front platforms must be so inclosed as to protect the motorman from unnecessary exposure. Fifty per cent of such cars shall be so provided by December 1, 1893, and all cars shall be inclosed by December 1, 1894. The bill has been favorably reported and is likely to pass. Our Minneapolis correspondent reports that President Lowry, of the great St. Paul and Minneapolis electric railway system, is willing to comply with the requirements of the law, and there should be no difficulty in enforcing it throughout the state. The measure is entitled to hearty approval, as there is no reason why electric cars cannot be operated without exposing the motormen to the severity of our northern winters. Laws of similar import should be placed on the statute books of all the northern states, and no doubt cable railway companies could also be included.

SEVERAL accidents on the Brooklyn electric lines during the last week have served to revive the old cry against the "deadly trolley." Our usually accurate contemporary, the *New York Times* departs from its conservative policy to make this petulant complaint:

> The slaughter and mangling of man and beasts by trolley cars or the currents from their broken or disarranged wires, where that death-dealing method of propulsion is in use, has become the daily subject of news items, and yet the State Railroad commission continues to give its consent to the extension of the system in this state. All the public advantage that comes from this "improvement" in the method of propelling street cars is no compensation for the suffering, bereavement and loss that it is constantly causing. It is the corporations alone that benefit by the privilege of killing and crippling in order to save expense and increase profits.

These statements are wholly unwarranted, and the best evidence of this fact is afforded in the accounts of the Brooklyn accidents printed in the news columns of the *Times*. There was no "slaughter and mangling of man and beasts" reported, but there were several accidents for which the victims were generally to blame. These accidents were usually of the class that follows the substitution of rapid transit systems on lines formerly operated as horse car systems. The unsophisticated people of Brooklyn, like their New York friends, are accustomed to rush in front of horse cars, and they need a little experience to teach them the necessity of keeping their eyes open and their wits about them. When they acquire this knowledge they will begin to appreciate the benefits of the new system. Surely our contemporary cannot seriously contend that the introduction of the electric railway is not attended by many advantages. These are recognized everywhere, even in New York, when Gothamites are not exasperated over their own woefully inefficient transportation facilities. There is no reason why the state railroad commission should prevent the extension of the trolley system. On the contrary, it should encourage the adoption of this method and insist upon improving the standard of construction work and the employment of competent motormen.

SELDOM is it the privilege of the WESTERN ELECTRICIAN to find such a frank admission by a gas man of the superiority of the electric light as that presented in the paper of Joseph Gwynn before the Ohio Gas Light association at its last annual convention. Mr. Gwynn, who is the general manager of the Gas & Electric company of Steubenville, O., recognizes the fact that gas cannot successfully compete with electricity for street illumination, and that the latter is preferable for commercial lighting where it can be secured. At a former meeting of the Ohio association Mr. Gwynn advised the members to take a practical view of the situation, putting aside their prejudices as gas men and engaging in electrical illumination in combination with their gas business. They would thereby gain whatever advantages would arise from the introduction of the new form of illumination and by securing possession of the entire lighting field would avert the ruinous competition which in many cases followed the advent of electric lighting in small cities. Since the Dayton meeting, at which this policy was urged, the electrical business has advanced far beyond the expectations of the most sanguine advocates. In Mr. Gwynn's paper are presented some interesting data, reproduced in another column, which were secured by personal application to more than 200 gas and electric companies. Evidence of progress in electric lighting is found on every hand. An idea of the growth of the arc lighting business alone may be gained from the statement that while in 1881 only a million carbons were manufactured and sold in this country, ten years later this branch of the business had grown until there were 145,000,000 carbons made and sold for arc lighting in this country. Incandescent lighting had grown apace and central stations were also reaping considerable profit from electric motor service. While this advancement was notable everywhere in electric lighting the gas companies were not keeping up with their rivals. In fact, in many cases the latter had lost ground. What was formerly a profitable department of the gas lighting business, street illumination, had almost entirely passed into the hands of the arc lighting companies. Out of 928 gas companies in the United States to-day only 435 have contracts for street illumination, and these are in great part doing a very limited business. According to Mr. Gwynn: "Street lighting by gas is being gradually displaced by electricity and will eventually be a thing of the past." If there be any doubt of the accuracy of this statement a close examination of the statistics gathered on this subject will convince any one that there is certainly good grounds for this assertion. During the last ten years 493 gas companies have lost their street lighting business entirely, and, as has already been pointed out, those still holding city contracts have lost considerable patronage of this kind and their business in this line is diminishing year by year. The advancement of the electric lighting business will continue, it is safe to say, and gas companies will suffer by competition, but, according to Mr. Gwynn, there is an excellent field for operation in the utilization of gas for heating and cooking purposes.

Electroctuion from a French Point of View.

MM. Biraud and Lacassagne of Lyons, France, have recently made an investigation of deaths caused by electric shocks, and in their researches, it is said, they have been aided by electricians throughout the world. After classifying and studying fatalities due to shocks, including the executions which have taken place in New York, the investigators announce that electricity causes death in two ways: First, by producing mechanical lesions of the blood vessels and nervous system; second, by stopping the respiration and the action of the heart. Deaths belonging to the former class are caused by lightning and static discharges from powerful batteries; but those of the second class are met with in shocks from high tension currents used industrially. A French paper in commenting upon the investigation takes up the subject at this point as follows:

These two classes of death are distinguished also in practice by a most important fact. While disruptive discharges of the first class cause death absolutely, the electric action in the second case most frequently puts the victims in a state of apparent death, and they can be revived by resorting to artificial respiration immediately after the accident. Thus, in accordance with a principle stated by D'Arsonval, which all those handling electric apparatus should know, a person who has received an electric shock should be treated exactly as one who has been apparently drowned.

The necessary consequence of these observations is that electrocution is complicated, barbarous and uncertain. None of our skillful physicians and physiologists has succeeded in killing with certainty a luckless rabbit, even by employing currents of 2,500 volts and 20 amperes. When the experimenter has believed he succeeded, it has still been possible to restore the animal to life by resorting to artificial respiration. Yet it is questionable if the machines used for electrocution in America give 1,500 volts.

D'Arsonval, some time ago, defied the American doctors to try artificial respiration on the patients immediately after the electrocution. Far from accepting the challenge, the doctors hasten to make an autopsy immediately after the electric shock. And this precaution does not seem to be useless, for experience now seems to have demonstrated that the victims have been thrown into a state of apparent death or cardiac and respiratory syncope. The autopsy thus is absolutely necessary to insure the execution.

The conclusion from these researches is that electrocution is not suitable for European countries, where love of novelty does not blind the eyes wholly to essential facts.

The Nomenclature Discussion.

The Paris correspondent of the London *Electrician* sends to that paper a brief report of the discussion in the Société Internationale des Electriciens on the reforms in electrical nomenclature proposed by the American Institute of Electrical Engineers, to be acted upon by the World's Electrical Congress. Following is the synopsis:

M. Blondel was of the opinion that the definition of "impressed electromotive force" was a bad one, and tended to confusion. He demanded its withdrawal. He wished to keep the expression "difference of potential," and considered "voltage" slang. In his opinion there was no need to replace the word "permeability" by "inductivity," which did not appeal to the mind so much. The committee of the American Institute of Electrical Engineers had defined "reluctivity" inaccurately, and the need for the term was by no means self-evident. He would suggest that the unit of illumination, the *lux*, should be equal to that of one bougie at one meter. He did not agree with the adoption of the Hefner-Alterneck amyl-acetate standard, which was difficult to use and of insufficient accuracy, while the carcel, or, better still, the Vinlle standard, were much more accurate. The speaker then exhibited a standard arc lamp based on the fact that the intrinsic brilliancy of the arc was constant. He had experimented, together with M. le Chatelier, upon carbons of various qualities, and had not observed any variation in their intrinsic brilliancy.

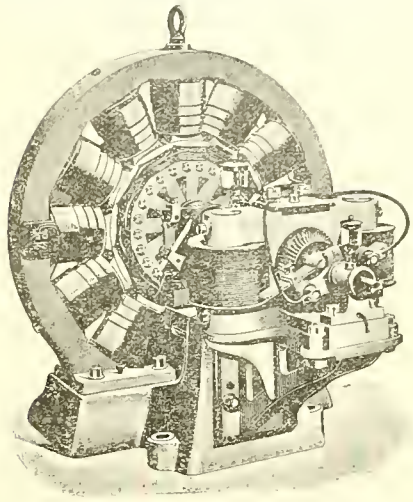
M. Guillaume suggested that the termination "ity" should be reserved for properties of matter—for example, "resistibility;" while the termination "ance" should denote a fraction—for instance, resist*ance*=resistibil*ity*×S | 1. The term "inductance" was unnecessary. "Inductivity" was useless; moreover, there was an error of sign in its definition. The word "permeability" was handier. He would support the names of "gauss" and "weber," but not those of "gilbert" or "oersted." In any case, the size of the practical units should be such that the system was coherent.

M. Hospitalier voted for the radical abolition of the expression "bougie-meter;" the unit of illumination was the bougie at one meter. M. Hospitalier then read a letter which he had received from M. Potier with which he entirely agreed. M. Potier held that the units should not be called absolute, but merely C.G.S. The "weber" was useless, since the C.G.S. unit of both total magnetic flux and of magnetomotive force sufficed. "Inductivity" had no *raison d'être* since we had "permeability." The expression "flux" was simpler and less ambiguous than "total induction." There was no need to give a special name to the ampere-hour or kilowatt hour.

The property and franchise of the Dubuque Electric Railway company has been sold by the Federal company to the Old Colony Trust company of Boston for $225,000 to satisfy the first mortgage held by the Bay State Trust company.

New English Alternator.

The alternating current dynamo represented in the illustration was built by Mather & Platt, Manchester, England, for a central station in New South Wales. The magnets are of wrought iron and arranged round the armature exterior to it, and are attached to a massive cast iron ring which forms the yoke connecting the limbs. The attachment is so arranged that any of the magnet cores can be removed without disturbing the remainder or taking out the armature. The yoke ring is made in halves, so that the upper part may be lifted to allow of the easy removal of the armature. The armature itself is constructed of two plates or disks keyed on to the shaft, between which the armature cores are held by bolts. As is



NEW ENGLISH ALTERNATOR.

the case with the magnets, any section of the armature can be removed without disturbing the remainder. Apertures in the disks allow free ventilation about the interior of the armature cores.

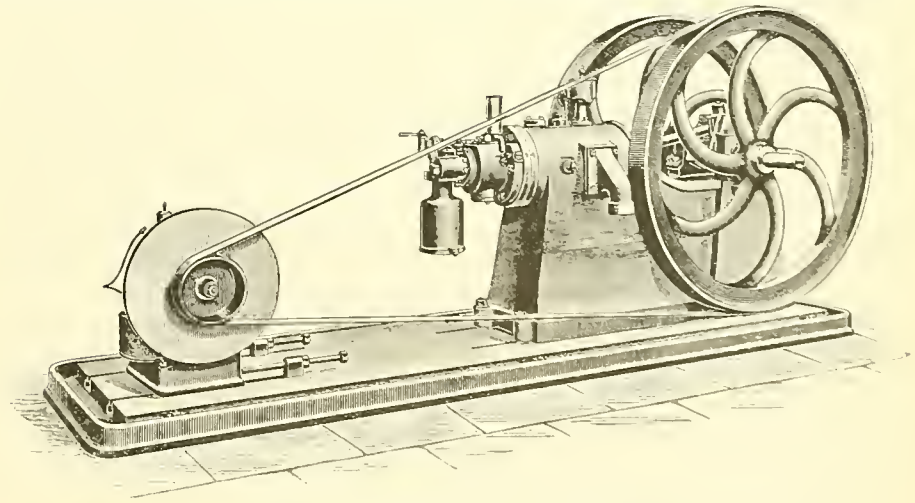
The machines are manufactured under the patents of Dr. John Hopkinson and Dr. Edward Hopkinson, and are designed for an output of 120 kilowatts at 1,000 volts, when running at 400 revolutions per minute. There are 24 poles, so that the number of reversals is 9,600 per minute, corresponding to a periodicity of 80. The resistance of the magnets is 16 ohms and of the armature .11 ohm, and the exciting current is five amperes. The electrical efficiency at full load is 98.4 per cent., and still higher at half load. Careful tests have been made of the commercial efficiency of a similar machine of somewhat smaller size by driving it from a motor of known efficiency and absorbing the power generated by the alternator in a non-inductive water resistance. These tests show a commercial efficiency of 92 per cent. Messrs. Mather & Platt have constructed a number of these alternators for central station work, from 16 kilowatts up to 200 kilowatts. The cut is reproduced from *Engineering* of London.

Not an Exorbitant Rate.

The *Times* of Forest Grove, Wash., says: "There is some talk going on relative to the erection of another electric light plant in our city. By a new process, so claimed by the San Francisco *Chronicle*, the common lights that are used can be furnished for 5 cents each per month. This is the kind that is contemplated here."

English Gas Engine and Dynamo Combination.

Both the English and the German have devoted more attention to the development of gas engines for the purpose of driving dynamos than have American inventors. A short time ago the WESTERN ELECTRICIAN illustrated a direct connected gas engine and dynamo plant made by a German firm, and the accompanying cut shows a combined gas engine and dynamo of English manufacture, the engine from the works of the Campbell Gas Engine company of Halifax and the dynamo from J. H. Holmes & Co. of Newcastle-on-Tyne. Both machines are mounted on the same bed-plate. The engine runs at 160 revolutions per minute, and is rated at 6½ horse power. The gas consumption is given at 24 cubic feet per horse power hour. This arrangement is compact and simple, and involves no sliding rails for belt tightening. The engine is said to run with perfect regularity, and to be completely under the control of a very sensitive governor. The illustration is reproduced from *Industries* of London.



ENGLISH GAS ENGINE AND DYNAMO COMBINATION.

Electric Railways in and About Chicago.

By the time the month of May has seen the World's Fair in operation and the people of Chicago and abroad are traveling about the city and its environs there will be in Cook county about one hundred and fifteen miles of electric railways, with thirty miles more promised by midsummer, says the *Chicago Record*.

On the south side the Chicago City Railway company will have in operation about ten miles of electric road, embraced within four main cross-town lines. On 35th street the electric cars will run west from State street to Western avenue, a distance of three and a half miles. Forty-seventh street will have a line from Cottage Grove avenue to Western avenue, a similar distance. Sixty-first and 63d streets will have about three miles of service. The cars will run east from State street on 61st, one line of cars going straight to Washington avenue, the other turning south on Cottage Grove avenue and approaching the fair grounds on 63d street. The Englewood line will traverse 63d street from State street to Ashland avenue.

The Calumet Electric Street Railway company now operates its line on Cottage Grove avenue from 72d street to 95th street, east to Michigan avenue, south to 124th street, with a branch running west on 119th street to Halsted street (West Pullman) and an east loop at 115th street to Kensington. The Burnside and South Chicago line is running on 93d street from Cottage Grove avenue to South Chicago avenue. The South Chicago avenue line from 75th street (Grand Crossing) to 95th street (South Chicago) with an extension to 92d street and Mackinaw avenue will probably be in operation next Sunday.

The Stony Island avenue line will run from 64th street to 97th street, connecting with the Pullman road into Pullman. On 75th street the cars will run from the Rock Island tracks in Auburn Park east to Stony Island avenue, and on 67th street they will run between Cottage Grove and Stony Island avenues.

The power plant for these lines are at Burnside street and Stony Island avenue, and the company promises forty-five miles of road in operation May 1st.

The South Chicago City railway lines will connect the Fair grounds, South Shore, Cheltenham, Windsor Park, South Chicago and Irondale. Cars will run on Stony Island avenue from 64th to 79th street, to Commercial avenue, to Notre Dame, to 104th street, to Torrence avenue, to 106th street, to the Indiana state line. From 106th street the cars will go north on Ewing avenue to 92d street, to Commercial avenue, and from 92d street to 87th street on Buffalo avenue.

Other branches are 87th street, from Buffalo to Superior avenues, to 83d street, to Ontario avenue and to 79th street. Seventy-ninth street, from Ontario to Commercial avenue, from 79th street to 71st street on Coles avenue, on 71st street to Yates avenue, to 67th street.

This covers about fifteen and one-half miles of track, which is all in operation excepting a portion of the Yates avenue line and the line from 79th street and Commercial avenue to the fair, all of which, it is claimed, will be going

inside a month. These lines connect with the Hammond, East Chicago and Whiting line in Indiana at 106th street.

The Chicago & Southwest Electric Railway Company will operate a line on 95th street from Oaklawn east, connecting with the Calumet line two blocks east of State street. There will be about seven miles of road, but it will hardly be in working shape before July 1st.

The Englewood and Chicago line will connect with the alley "L" at 63d street and Vernon avenue, going south to 67th, east and west on 67th, connecting with Cottage Grove avenue and State street; also south on Vincennes avenue from 67th to 71st street, east and west to Cottage Grove avenue and State street, south on State to 79th street to Vincennes road, thence southwesterly to 103d street, with branches on 87th to Loomis street and to Cottage Grove avenue. There is a branch also on State street from 95th to 79th street, and making connections on 95th street with the Calumet electric at Michigan avenue. These lines will cover eight to ten miles of road. The 87th street and Vincennes road lines are expected to be operating in connection with the elevated road at 63d street by July 1st.

The Cicero and Proviso company is operating its lines on West Madison street, Lake street and Harlem avenue and on Desplaines avenue to 12th street, a total of twenty-two miles. New branches are to be in running shape by June 1st from Madison street at the Desplaines river west to Ferman avenue, with a branch north to Melrose and another south to 12th street, making about six miles.

The West and South Towns Street Railway company will operate on 22d street, through the lumber district west to Crawford avenue, with a branch on Lawndale avenue from 22d to 35th street. The road is now built on 22d street and Lawndale avenue. The company promises twelve miles of the line to be in operation by May 1st.

The Chicago-North Shore Street railway company's route is from Graceland avenue on Evanston avenue to the city limits, to Chicago avenue and Rogers Park, thence north to Evanston. This line embraces sixteen miles of road, of which about half will be in operation by May 1st.

The Present and Future Competition Between Gas and Electricity.[1]

By Joseph Gwynn.

In order to get at the inwardness of both branches of the industries and to treat them fairly from an unbiased standpoint and produce a paper based on actual facts and fig-

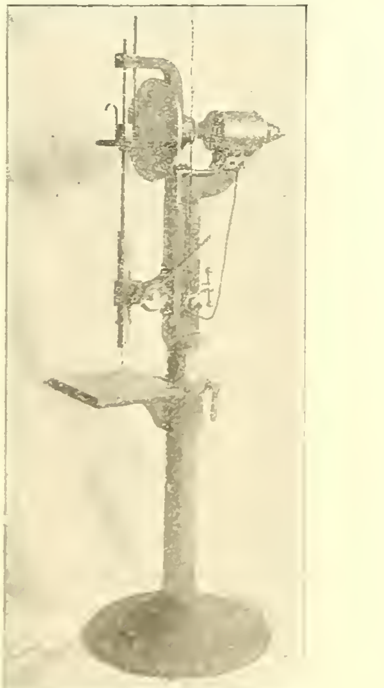


FIG. 5. STOREY'S SOLENOID MOTOR FOR DIRECT MACHINE DRIVING.

ures, and not one written from my own views on the subject, I communicated with upward of two hundred gas and electric companies in different parts of the United States, in order to obtain as reliable data as possible on the subject to be treated. To show the rapid advancement of one branch of the electric business, which is arc lighting, I append the following figures, showing the growth of the carbon business. Upon the introduction of the arc lighting business, from the year 1879 to the year 1881, only a small amount of carbons was manufactured, and from what data I can obtain the total sales of carbons would not exceed one million per annum, with prices ranging from $120 to $150 per thousand. From 1881 to January 1, 1892, the amount of carbons manufactured and sold in the United States had gradually increased until to-day there are upward of 145,000,000 of carbons being manufactured and sold annually, with price ranging from $9 to $10 per thousand. From these figures it will be seen that the arc lighting business has shown an average advancement of over 12 per cent. per annum for the last twelve years. While the arc lighting business has shown a rapid advancement for mainly public lighting, what effect do we find this has had upon public lighting by gas companies? To-day out of over 928 gas companies in the United States we find that only 435 have contracts for street lighting and 493 have lost the street lighting business entirely, the gas business being displaced by arc and some few incandescent lights, while, on the other hand, a great many of the gas companies who still do street lighting do only a limited business in this line, as street lighting by gas is being gradually displaced by electricity and will eventually be a thing of the past. Let us again consider the two great competitors from a commercial lighting standpoint, and what are the results? The aggregate gain in output of 27 gas companies for the year 1891 is 6.56 per cent., and for the year 1892, 6.61 per cent., or a net gain of 13.61 per cent. for the output of 1892 over that of 1890. For comparison, I will now show the aggregate gain of the commercial electric lighting business. In 1891 the aggregate number of incandescent lamps then installed by fourteen electric companies was 16,475 and in 1892, the aggregate number of lamps then installed had reached 33,238, showing a net gain of over one hundred per cent. in the past year. From the above figures it will be plainly seen that the net increase of commercial incandescent lighting for the past year over gas is ninety-three per cent. In addition to the incandescent lighting business of the above electric companies, I find that in 1890 they had then installed 1,047 commercial arc lights, and in 1891 they had increased to 1,149, and in 1892 to a total of 1,620 lights,

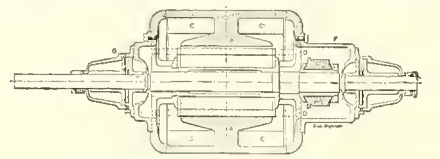


FIG. 1. STOREY'S SOLENOID MOTOR FOR DIRECT MACHINE DRIVING.

showing a net gain in the past two years of over fifty-four per cent.

Again, let us look at the lighting question. It has been claimed by most gas managers that electricity could not compete against gas for day lighting, as the business was not sufficient to justify an electric company to operate day circuits only in large cities. In this respect, I wish to say that they have been mistaken, for I find that quite a number of electric companies in cities of 20,000 population and under are operating day circuits, or, in other words, are operating their plants for the full twenty-four hours. I am asked how they can afford to operate a day circuit without continual loss. I wish to reply to this question by saying that in addition to what lights are required, the constant demand for ventilating fan motors, from which a good revenue is derived, enables an electric company to operate a day circuit at a small profit. To give you an idea of the growth and prosperity of the ventilating fan motor business, which is being rapidly introduced by electric companies, I append a few figures obtained from the manufacturers as to the sale of fan motors for the years 1891 and 1892. In 1891 the sale of fan motors by four of the principal electric companies was 2,012. In 1892 the sale of fan motors by the same companies was 5,093, and the companies above referred to stated in their report, to me that from the present outlook the sales of fan motors for the year 1893 will be fifty per cent. greater than for the previous year. In order to further enlighten you on the possibilities of electric companies operating day circuits, I wish to call your attention to the following figures showing the enormous increase in the sales of motors used for isolated purposes and independent of street car use. In the year 1889 the sales were, practically speaking, nothing, as the reports obtained show an aggregate sale of 175 horse power. In 1890, the aggregate sales of motors of five of the principal electric companies show 6,584 horse power. In 1891 the aggregate sales of motors by six of the principal electric companies were 9,657 horse power, and for the year 1892 the aggregate sales of seven of the principal electric companies were 19,216 horse power, or, in other words, the total sales of motors for the past three years by seven of the leading electric companies show an aggregate of 35,457 horse power. This branch of the business, if you will stop to think, comes in competition with the gas engine business, and while I have no figures to show the aggregate horse power of gas engines sold for the same period, yet at the same time I venture the assertion that twenty-five per cent. of the sales of motors would be a fair estimate for the sales of gas engines. This branch of the motor business, looking at it from an electric standpoint, is not as easy to handle, nor possibly not as profitable, as is the gas engine business to gas companies. While the gas company can furnish the gas required for gas engines through the same line that is used for illuminating purposes and without increased expense, it is im-

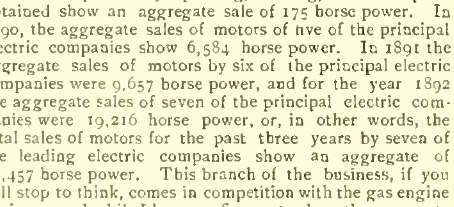


FIG. 2. STOREY'S SOLENOID MOTOR FOR DIRECT MACHINE DRIVING.

possible for electrical companies to furnish current for motor use from the same circuit used for lighting. As I stated above, fan motors can be operated on the electric lighting circuits, but when an electric company undertakes to operate anything larger than fan motors from a lighting circuit, the continual stopping and starting of the motor will cause a variance in the lights

[1] Abstract of paper read at the meeting of the [illegible] Gas Light association at [illegible], March [illegible], 1893.

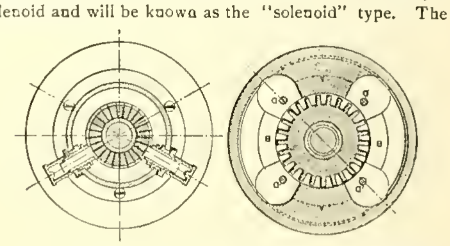
Storey's Solenoid Motor for Direct Machine Driving.

Until recently the electric motor has simply been used to supply the place of engines and other motive power in operating the ordinary methods of power transmission—that is, by means of shafting and belting. In overcoming this disadvantage, I. E. Storey has developed a motor that is attracting considerable attention.

The motor is a plain cylindrical machine having end projections for the boxes and commutator. Fig. 1 shows a longitudinal section through the T-shaped pole pieces, which project internally from the cylindrical portion of the machine. Fig. 2 shows a longitudinal section through the poles projecting from the end portions, Fig. 3 a cross-section through the poles and Fig. 4 a cross section through brush holder and commutator. In Fig. 1 *A* represents the cross-section of the cylindrical portion as noted, showing the two T-shaped fields; *B* in Fig. 2 shows the opposite field pieces carried by the cap ends; *C* in both drawings represents the cross section and location of the field windings; *D* shows the bolts which are used in assembling the main portion of the magnetic fields.

One of the unique features of this machine consists in the construction of the field magnets, which, as shown, present four poles, so arranged that, while the center of the machine is of one polarity, the ends are of opposite polarity, both ends being of the same polarity. From this it will be readily seen that, while this is a four-pole machine, it has eight distinct magnetic circuits, making the path of the magnetic lines uncommonly short and of very low resistance, giving maximum efficiency for minimum quantity of wire. The coils *C* wound on spools to size are removed from the spools thoroughly insulated, slip loosely in the cylindrical chamber and occupy a position in a plane perpendicular to the center line of the shaft, and are held in position by the pole pieces *A* and *B*.

The armature is of the drum type, toothed. The end caps *F G* serve for supports, and form the outside chambers for the self-oiling bearings. The end cap *F* carries the brushes, which are shown in Fig. 4. The bearing are designed and constructed so that the motor can be placed in any position as long as the center line of the shaft is horizontal, the end of caps *F* being protected by a cap projecting over the opening of the box, thereby rendering the boxes impervious to dust and moisture. In cases where there is much moisture these caps are replaced by stuffing boxes. It will be noted that this machine is practically a solenoid and will be known as the "solenoid" type. The



FIGS. 3 AND 4. STOREY'S SOLENOID MOTOR FOR DIRECT MACHINE DRIVING.

motor is practically a hermetically-sealed machine. Thus it is protected on the outside against moisture, dust or any possible external injury, and being entirely enclosed no outside injury can possibly arise from any internal condition incident to the operation of the motor, such as burning-out of armature, or fields, or sparking at the brushes. These features make the motor water, dust and fire-proof, and hence adapt it to an enormous range of work.

The form of Mr. Storey's motor permits a combination of motor and tool such a is shown in Fig. 5, which is a 12-inch upright drill of the friction type. An examination of this combination will readily suggest to the mechanical mind the ease with which this motor can be applied to lathes, planers and other machine tools as well as all types of machinery requiring high and constant speed, notably wood-working machines of all varieties.

The manufacturers of this motor, the Hornell Iron Works, Hornellsville, N. Y., are now prepared to furnish motors adapted to grinding and buffing, operating drills and transmission of small power. The Dahl Electric company, 120 Liberty street, New York, is the agent for the manufacturers for the eastern and middle states.

A thirty-ton electric traveling crane has been installed in the new "river works" of the Thomson-Houston factory, at Lynn.

Articles of incorporation of the Stockton, Cal., Power Transmission company (capital, $1,000,000) were filed recently. The company will utilize the water power on the Mokelumne river, forty-two miles from Stockton. The company will supply electricity for a railroad between Stockton and Lodi.

New Fan Motors.

The accompanying cuts show two types of motors that have just been placed on the market by the Calumet Electric Manufacturing & Engineering company, Chicago. These machines were built after designs prepared by George E. Dorman, Chicago, and embody a number of novel features. Referring to the illustrations, Fig. 1 shows a 500 volt fan motor apart, and the drawing, Fig. 2, represents the design of a fan for 110 volt circuits. The most important feature in the construction of these machines is the size of the armatures. This part is of unusually large diameter, thus affording exceptionally large space for insulation, a construction very necessary where so small a machine is designed for circuits of so high a potential as 500 volts. The armature of the Calumet company's machine has numerous coils and commutator segments, and in operation, it is claimed, is absolutely sparkless. A close inspection of the machine reveals another important feature in the brush holder. This part consists of a small tube containing a spring and the brush, which is really a pencil of carbon. The brush yoke is made in one piece with the journals. Lubrication is afforded by "greasers"

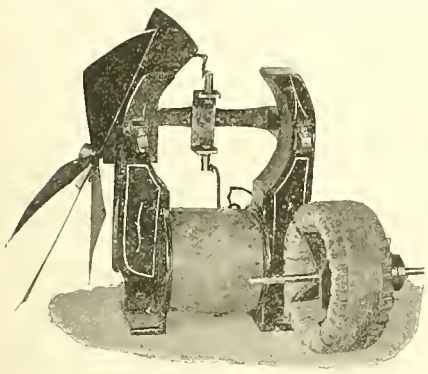
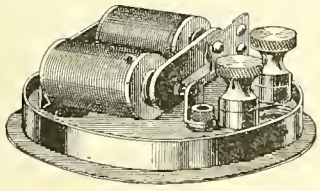


FIG. 1. NEW FAN MOTORS.

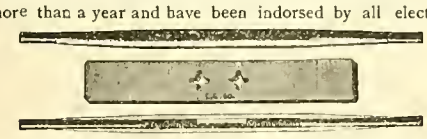


POCKET BUZZER

or self-oilers. These machines are manufactured in the following sizes: 1-16, 1-12, 1-8, 1 5, 1-2 horse power for 110 and 220 volt circuits, and 1-8, 1-5 and 1-2 horse power for 500 volt circuits. It should be mentioned, also, that the company has in course of construction several larger motors and dynamos.

Wood's Splicing Tube and Threading Tool.

The accompanying cut illustrates the splicing tube manufactured by the Ansonia Electric company (formerly the Electrical Supply company), Chicago. The connector is made in one piece, threaded on the inside with a right and left hand thread. With the aid of a threading tool, this splicer can be adjusted to the trolley wire in a very few minutes. These trolley splicers have been in use for more than a year and have been indorsed by all electric



WOOD'S SPLICING TUBE AND THREADING TOOL.

roads using them. The splicer can be furnished with slots cut into it to admit of soldering, but this is not necessary, as the breaking strain without the use of the solder is 3,000 pounds; with the addition of the solder it will stand a strain of 4,500 pounds without affecting the threads inside. This test was made by the Chicago City Railway company, the strain having broken the trolley wire without doing any damage to the splicer, or even stripping a thread. The splicer constitutes practically a continuous wire and causes no sparking or flashing as the trolley wheel passes.

Pocket Buzzer.

The Partrick & Carter company's pocket buzzer, shown in the cut, is a novelty which bell fitters and wiremen will appreciate. It is small and is made entirely of metal. It gives a clear, loud and pleasant sound and is also adapted to the same uses as larger buzzers.

Primary Battery Tests.

A recent comparative test and close study of seven dry cells made for commercial purpose by different manufacturers developed some interesting results, which are graphically shown by the curves in Fig. 1. The curves show to excellent advantage the state of perfection to which the various cells have been brought up to date, and it is especially interesting to note that a continuous advance has been made, all of the modern cells being vastly superior to the first or older forms. The poorest results were obtained from the oldest battery, or that which has been on the market the longest time, all the better ones being of later

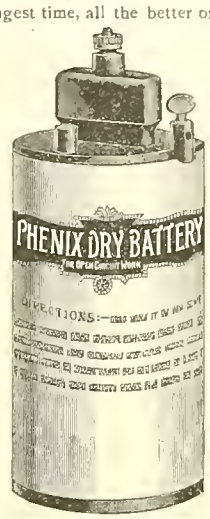


FIG 2. PRIMARY BATTERY TESTS.

production. Cells No. 6 and 7 gave results so nearly identical with those of cell No. 5 that their curves are not shown on the plate. These two cells, furthermore, were so much alike in construction as to leave scarcely any doubt that the only difference between them was the difference in the labels.

The tests were made by the condenser method, two Carhart-Clark standard cells being used as the standard of electromotive force. The external resistance used in circuit with each cell was five ohms. The small divisions of the scales, read horizontally, represent thirty seconds of time each, and vertically, two one hundredths of a unit of electromotive force, current and resistance respectively, i. e., one small division, vertically, represents two one-hundredths of one volt for the potential difference, polarization and recovery curves; it represents two one-hundredths of an ampere for the current curves, and two one-hundredths of an ohm for the internal resistance curves.

It will be noticed that the duration of the test was about one hour, and that most of the cells maintained a practically constant current during three-fourths of the time of the test. The test was made by Prof. S. W. Stratton of the department of physics, University of Chicago. Cell No. 1 was a Phenix dry battery, manufactured by the Western Electric company, Fig. 2, and its efficiency will be apparent after a study of the curves.

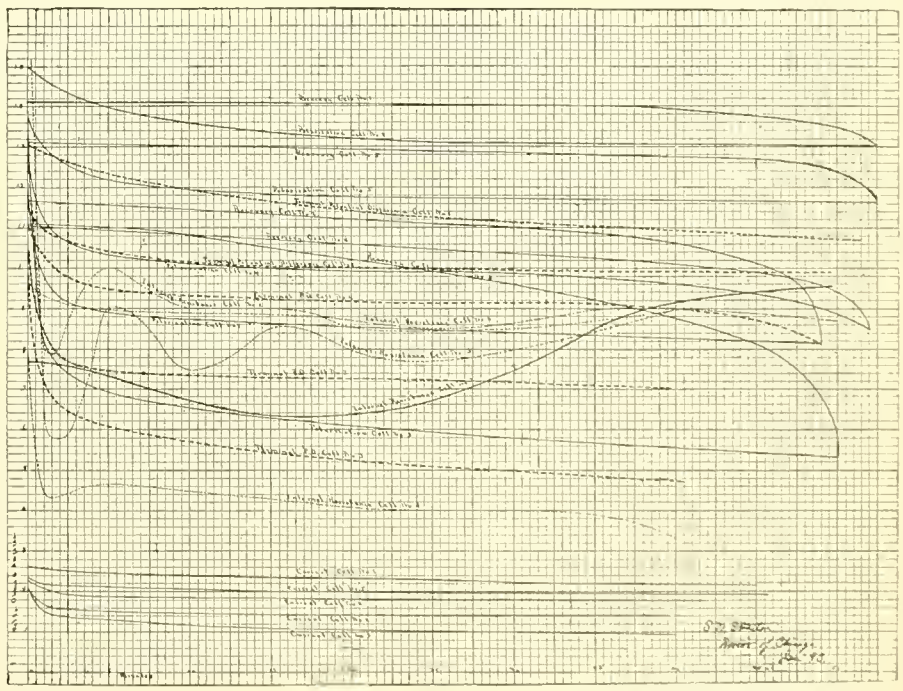


FIG 1. PRIMARY BATTERY TESTS.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 25.—While the Rapid Transit commission, the Manhattan Railway company and the city officials are quibbling over the terms of extending the present "L" road service, so as to give at least temporary relief to the people of this much-crowded city, the Legislature at

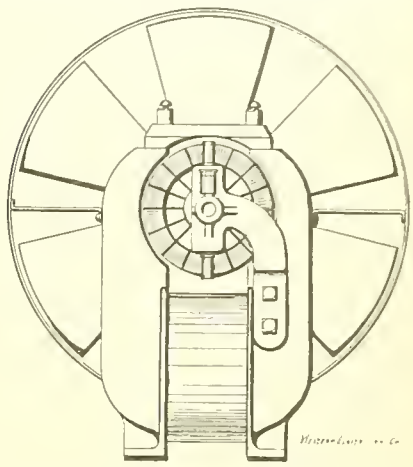


FIG. 2. NEW FAN MOTORS.

Albany is considering the proposed rapid transit bills advocated by Assemblymen Ellison and Farquhar. At a meeting of the Assembly cities' committee on Thursday afternoon Assistant Corporation Counsel Blandy of New York city, said the city authorities were unqualifiedly opposed to the bills. They objected to the scheme for the appointment of a new commission and directing it to lay out a route to be sold to the highest bidder, and also to the proposition that, if it could not be sold, the city should build the road. Under the constitution the city could not go into road building, and the charter gave it no such permission. The Court of Appeals, in a recent decision, says that railroad building is no part of municipal functions. Mr. Farquhar said it was exactly as proper for the city to build a roadway upon which a lessee is permitted to run cars as to build aqueducts and engage in the business of furnishing water. The increase in the value of real estate in the upper part of the city would pay all the expenses of building the road. The renting of the privilege of using the road would pay the interest and put a sum into the sinking fund that would completely pay for the work in thirty five years. New York city has $50,000,000 to expend before it reaches the legal limitation of indebtedness. The estimated cost of building the road was $50,000,000,

and it would probably cost the lessee $300,00,000 to equip it. But he did not believe the city would ever be called upon to build the road. He was sure that private capital would be found ready to come in. B. F. Romaine of the New York Real Estate Exchange, spoke of the great value of the proposed roadbed, which would increase in value as did the docks built by the city. There is little prospect of the rapid transit bill appearing this year, as six of the members of the committee are understood to be against the bill, which leaves only five for it.

In the discussion over the bill providing for a commission to regulate telephone charges the senate had a lively time on Monday night. Many of the senators who favored a similar bill a year ago were found to be arrayed on the side of the telephone company. Only four members voted to take the bill from the committee. It is quite probable that nothing will be done this session in the matter. It is an interesting fact that Senator Plunkett, who reported a similar bill last year and urged its adoption, was the leader of the telephone company's friends in the senate Monday night. Senator Cantor also voted for the bill last year, but is now opposed to it. With these leaders favorable to the telephone interests it can hardly be expected that the petitions of the subscribers will be favorably acted upon.

Mayor Gilroy, in an interview on rapid transit, is reported as follows: "I want to be put down as opposing all these bills at Albany. I oppose them most emphatically. Indeed, I will do all possible to prevent the success of any project which purposes the investment of public money in what I believe to be a private franchise and entirely within the province of private capitalists to handle. I want to be fully understood on that point."

On Friday of last week Deputy Sheriff Carraher took charge of the office of the *Electrical Age* Publishing company in the Pulitzer building on two attachments for $1,643 the largest being in favor of John B. McGeorge for $1,200.

Ex-Mayor Patrick J. Gleason's scheme of building an electric railway from Long Island City along Jackson avenue to Flushing has met with a setback. An injunction has been served upon Mr Gleason, who is president of the company, restraining the Long Island & Newtown Railroad company from laying rails along Jackson avenue. This thoroughfare was macadamized at a great expense by the towns of Newtown, Flushing and North Hempstead. Mr. Gleason holds a franchise from the highway commissioners of the town of Newtown, and it is asserted that he will have to secure a similar privilege from the towns of North Hempstead and Flushing before attempting to resume operations. W. F. O.

Northwestern Notations.

MINNEAPOLIS, March 25.—It is not probable that a large amount of construction work will be done this season by the Twin City Rapid Transit company. Unless the St. Paul tangle is unravelled soon President Lowry is not likely to construct extensions that he recognizes ought to be made. In Minneapolis scarcely any complaint is heard either as to the extent or character of the service. The new ordinance, about which so much ado was made at first, has been in force some time and the feeling over the matter appears to have subsided. The proposed transfer depot at Bridge Square has not been built and may not be. The talk about a new loop, up Hennepin avenue to Sixth street, will probably not materialize this year.

In all probability the second inter-urban line, via St. Anthony Park and the State Fair Grounds, will be constructed this season. There is a gap of only two miles between the termination of the Como avenue line from Minneapolis and the terminus of the St. Anthony Park-Langford avenue line from St. Paul. The feasibility of connecting the two and thus getting another through line between the cities has been evident to President Lowry for some time, but he has had so many pulls on his purse string that he has waited for interested property owners to help him. This, they have agreed to do to the extent of a bonus of $3,000, cash, and $17,000 real estate. The agreement calls for the commencement of work on the new line, soon after April 1st and satisfactory through service on the completed line from 6 A. M. to midnight. Citizens also agree to grade the streets en route and much of this work has already been done.

The substitute ordinance which it was hoped might adjust difficulties between President Lowry and the St. Paul authorities was referred to the committee on streets by the board of aldermen. This action is generally interpreted as pointing toward a possible agreement upon a compromise ordinance.

The recent storms have effected the telegraph and telephone companies as well as the street railway people. The trouble was due principally to the coating of ice that formed on the wires. At the St. Paul telephone exchange a fire was started in the terminal room and burned out half the wires before it was put out, entailing a loss of perhaps $1,000. Between this misfortune and the loading up of the wires the telephone service was considerably crippled.

The Independent Telephone company, which has been quietly operating in St. Paul for some time with what it calls the magnetophone, has been incorporated with Walter S. Morton, president of the St. Paul & White Bear Electric Railroad Company as president. It is not the intention to compete with the Bell company on an exchange system at present. The capital stock is only $10,000. The company will operate a number of private systems in large plants. Where an officer of a company in such a case desires telephonic communication with his subordinates, under the old system it would cost him $6 per month for each telephone. This new system, however, is placed in operation and sold outright. The manager has a transmitter and switch board on his desk and can talk to any part of his establishment without calling up any central office. The company hopes in time, however, to establish a general system. It is claimed that the magnetophone is an infringement of the patents controlled by the Bell company. Patent lawyers are examining the claims of the companies, and upon their verdict depends the question of fighting the case out in the courts.

The Brainerd Electric Railway company has filed articles of incorporation in St. Paul. The capital stock is $75,000 and the incorporators are C. H. Parker of St. Paul; Ray W. Jones, of Minneapolis and Fred S. Parker of Brainerd.

The city council of Butte, Mont., has granted a franchise to the Montana Mutual Electric & Telephone company. Work is to be begun on the plant within six months and be completed within one year. The company is to furnish light and telephone service to the city free.

H. R. Fisher, Jr., and F. B. Fargo, of the Royal Electric & Water company of Lake Mills, Wis., have been in Austin, Minn., figuring on putting in a light and power plant. There is considerable complaint of the service given by the present company.

At Spring Valley, Minn., the business men have organized the Spring Valley Electric Light Investment company to put in an electric light plant and possibly water works. B. F. Farmer is president and S. C. Labdil, E. W. Thayer, J. S Lee, M. E. Molstad, J. B. Viall and T. A. Sorenson are directors.

The scheme for running an interurban electric railway between Eau Claire and Chippewa Falls, Wis., seems to be well under way. It is said that the right of way has been secured. N. L. P.

Milwaukee, Wis.

MILWAUKEE, March 25.—There is good evidence that the project of building an electric line between Chicago and Milwaukee, which was first agitated about two years ago, has been quietly pushed during the time that has since elapsed. It is said that the entire right of way has been secured. The capital stock of the company is $10,000,000. The Milwaukee gentlemen who are most directly interested in the project are Henry C. Payne and C. C. Rogers. It was originally the intention to operate the road during the World's Fair. In a short time, however, it was found that such a feat was out of the question. The whole line will be in operation within the next five years. Between Milwaukee and Racine, it is said, electric cars will be running in three years, possibly in two years. It is announced that trains of two or three cars will be run at intervals of a half-hour or of an hour, and that the trip will be made in an hour and twenty minutes. The road will take in Cudahy, South Milwaukee, Racine, Kenosha, Evanston and South Evanston. In Chicago the road will be elevated, as it was found to be impossible to secure a right of way for a surface road in the World's Fair city.

A project for an electric railway between Neenah and Kaukauna, taking in Menasha, Appleton and Kimberly is taking form. It is intimated that some large electric concern which is interested in street railways in many places in the West is at the bottom of the deal. The men who have made the deals for the present street railway systems of Appleton and Neenah have guaranteed $300,000 with which to put in twelve miles of road from Neenah to Kaukauna. One plan is to build a line from Neenah to a point near Appleton on an old road-bed owned by the Wisconsin Central Railroad company. Thence the road would be extended to Appleton and on to Kaukauna, following the east bank of the Fox river. This is considered the best plan, but if it cannot be carried out, the line could be built on the west bank of the Fox river at little additional expense. The farmers are very anxious to have the line built, and are willing to donate land for the right of way. The line might be extended to Green Bay, taking in Wrightstown, Depere, Fort Howard and several smaller places. There is also talk of an electric line running from Oshkosh to Berlin, taking in Winneconne, Omro, Delhi and Eureka.

At a meeting, a few days ago, of the Common Council committees on judiciary and railroads, Henry C. Payne entered an emphatic protest against the time schedule for the Milwaukee electric lines which it is proposed to adopt. He said that the company is having a hard time of it now, and that if it were hampered with legal restrictions it would soon be in the hands of a receiver. The aldermen were of the opinion that they had the right to fix a schedule for the operation of the road, but they finally consented to a postponement of the ordinance until the matter could be more thoroughly discussed.

The morning following the meeting in question Mr. Payne specifically reiterated his assertion that the road would be in the hands of a receiver if it were made the subject of restrictive legislation. He further declared that the prospect of injurious legislation had rendered it impossible for the company to raise the $2,000,000 or $2,500,000 which it had calculated to expend on its lines in the city during the present year. At the present time, he said, the road is not earning sufficient money to pay the interest of 5 per cent. on its bonds. The company as yet has barely paid the operating expenses. The payment of the city and state tax which it was proposed to exact was simply out of the question. From these statements it appears that the misfortunes that the corporation had suffered have materially reduced the earnings of the road while putting the company to extra expense in order to meet the contingencies.

Owing to the burning out of the switch-board at headquarters last Monday Milwaukee's fire alarm system was totally disabled. The accident occurred shortly before 11 o'clock Monday night, and, it is supposed, was caused by an arc light wire or electric railway wire coming in contact with a fire department wire. The only notification of the accident at headquarters was a tremendous clicking in the operating room, and the operators thought that every box in the city was being "pulled" at the same time. The battery room was found all ablaze. The fire itself was quickly extinguished and the work of repairing the wires was begun.

At the last meeting of the Common Council more street railway legislation was proposed. Alderman Straub, of the Ninth ward, introduced an ordinance to repeal the franchise of the Milwaukee Electric Railway Company, or Hinsey line, on Eighteenth street from Vliet street to Fond du Lac avenue. Mr. Straub said that the company had not operated a single car on that line for three months, and that the people demanded cars or the removal of the tracks and poles. The matter was referred. Aldermen Weiber, of the Eighteenth ward, introduced a resolution, which was passed under suspension of the rules, directing the Milwaukee Street Railway company to remove its tracks on North Water street from Brady street to Warren avenue, a distance of six blocks. Mr. Weiher asserted that the company's tracks were in such poor condition that they rendered the street impassable.

Judge Johnson, of the Circuit Court, has issued an order allowing Receiver Melms, of the Hinsey line, to issue certificates to the amount of $5,500 with which to pay the deficit.

The Crowdus Chemical Electrical company, which was organized in this city a few weeks ago, may erect a factory soon. The company owns patents on small motors and portable batteries for residences and offices. The capital stock is $75,000. W. S. Baker of Chicago is interested in the company. C.

PERSONAL.

Otto Kuhn, representing the Frank Adam Electric company, St. Louis, was in Chicago last week.

Charles Wirt, electrical engineer of the Ansonia Electric company of Chicago, was in New York last week.

S. Dana Greene of the General Electric company made a brief visit to some of his old Chicago friends last week.

William B. Roberts, general manager of the Rockford Electric Manufacturing company, Rockford, Ill., was in Chicago a few days during the last week.

Allen R. Foote, late special officer of the census bureau for the collection of electrical statistics, is a candidate for appointment by President Cleveland to the office of railroad commissioner.

G. M. Dugan has been appointed superintendent of telegraphs of the Illinois Central Railroad Company with headquarters at Chicago. C. F. Annett has been named assistant superintendent. He will also be stationed in this city.

H. Laws Webb left for England last week on the steamer Majestic, in the interests of the Electric Selector & Signal company of New York. It is stated that the foreign de-

mand for this company's appliances is assuming large proportions. Mr. Webb will be gone for some time.

Dr. F. A. C. Perrine, treasurer of the Germania Electric company of Boston, has resigned his position and has accepted the chair of electrical engineering at the Leland Stanford, Jr, University at Palo Alto, California. His new position will begin with the ensuing college year, about August 1st, before which time he will make a thorough investigation of electrical engineering apparatus and of the exhibits at the World's Fair. Dr. Perrine was educated at Princeton University, which he entered in 1879; the degree of A. B. was conferred upon him in 1883, D. Sc. in 1885 and A. M. in 1886. After leaving the university, he entered the service of the United States Electric Light company in Newark, N. J., as assistant electrician, which position he held for three years. Later he was appointed superintendent and manager of the insulated wire department of the John A. Roeblings Sons' company, at Trenton, N. J., in which capacity he served for four years. About a year ago Dr. Perrine went to Boston, to act as treasurer of the Germania Electric company. Dr. Perrine has devoted much time to writing and scientific investigation, and has produced much valuable data and information relating to electrical engineering. He is well fitted for his new position.

NEW INCORPORATIONS.

Long Island Traction company, Norfolk, Va.; capital stock, $3,000,000; manufacturing and supplying power for railroads, etc.

Rockland Electric company, Ramapo, N. Y., capital stock, $25,000; manufacturing and sale of electricity for light, heat and power.

Granite Land company, Manchester, Va.; capital stock, $40,000; real estate and improvements, tramways, water, gas and electric works.

Electrical association, Portland, Me.; capital stock, $500,000; to own, equip and operate electric plants; Coombs & Neal, Portland, Me.

Mutual Light company, Alliance, O.; capital stock, $150,000; operating electric light plant and gas works; Fording & Harris, Alliance, Ohio.

De Pere Electric Light & Power company. De Pere, Wis.; capital stock, $20,000; operating an electric light and power plant; C. G. Wilcox, De Pere, Wis.

Madera Electric Light company, Madera, Cal.; capital stock, $100,000; to build, construct and maintain an electric light plant; R. L. Hargrove, Madera, Cal.

Jackson Light & Power company, Jackson, Mich.; capital stock $100,000; generating and furnishing electric light, power and heat; William A. Foote, Jackson, Mich.

Worcester Construction company, Worcester, Mass; capital stock, $20,000; the construction of electric and other railroads; Geo. M. Woodward, Worcester, Mass.

Heat, Light & Power company of New Jersey, Trenton, N. J; capital stock, $200,000; to manufacture and sell gas and electric supplies, etc.; W. Holt-Apgar, Trenton, N. J.

Stockton Power Transmission company, Stockton, Cal; capital stock, $1,000,000; to buy and sell every kind of electrical machinery and appliances; S. D. Woods, Stockton, Cal.

Mutual Electric Light & Power company, Chicago, Ill.; capital stock, $75,000; to furnish electric light and power to the people of Chicago, Ill.; William A. Conover, 115 Monroe street, Chicago, Ill.

Southwestern Railway company, St. Louis, Mo.; capital stock, $3,000; building and operating a street railway and the manufacturing of electricity; Smith P. Galt, Fifth and Olive streets, St. Louis, Mo.

Coos & Grafton Electric Light, Heat & Power company, Lancaster, N. H.; capital stock, $50,000; manufacturing and distributing electricity for light, heat and power; Ladd & Fletcher, Lancaster, N. H.

Consolidated Electric company, Greenwich, N. Y.; capital stock, $35,000; formed by the consolidation of the Greenwich Electric Light & Power company and the Cambridge Electric Light & Power company.

Mount Vernon Electric Railway & Light company, Mt. Vernon, Ohio; capital stock, $400,000; constructing and operating electric railways, furnishing light, heat and power, etc.; P. B. Chase, Mount Vernon, Ohio.

Speer Electric Transit company, Passaic, N. J.; capital stock, $100,000; to construct and build railways and cars according to the plans and patents of Alfred Speer and to sell the same, etc.; Thomas M. Moore, Passaic, N. J.

West Baltimore Land company, Louisville, Ky.; capital stock, $300,000; general real estate business, both real and personal property, building of streets, gas or electric works, water works, houses, bridges, electric or other railways.

Hudson & Bergen Traction company, Hoboken, N. J.; capital stock, $5,000,000; to authorize the formation of traction companies for the construction and operation of street railways, etc.; Albert C. Wall, East Orange, N. J.

Chestnut Hill & Norristown Passenger Railway company, Philadelphia, Pa.; capital stock, $48,000; constructing and operating an electric railway from Philadelphia to Norristown, Pa.; Francis Rawle, 328 Chestnut street, Philadelphia, Pa.

Passaic, Bloomfield, Montclair & Caldwell Electric Railway company, Passaic N. J; capital stock, $200,000; to construct, maintain and operate a street railway for the transportation of passengers, etc.; John Kennell, Paterson, N. J.

Canton Water Works & Electric Light company, New Orleans, La.; capital stock, $50,000; building and operating water works and electric lights in the city of Canton, Miss., and the purchasing of contracts, privileges and franchises; Irwin Jamison, New Orleans, La.

Treichler Water & Light company, Camden, N. J.; capital stock, $100,000; storage, transportation and sale of water and water powers, privileges, supply and distribution of electricity with the right to take rivulets and raceways; Howard M. Cooper, Camden, N. J.

Portable Electric Light & Power company, Peoria, Ill.; capital stock, $250,000; to manufacture, sell and rent in Peoria county, Ill., electric inventions, batteries, motors and supplies for electric light and power plants, also to buy and deal in real estate if necessary; I. Mantz, 209 Main street, Peoria, Ill.

Alexandria Electric Light & Power company, Alexandria, Ind.; capital stock, $30,000; to furnish electric light for Alexandria, to light the public streets and for private individuals and corporations, and to furnish electricity for motive power or any other purpose for which electricity may be used; Joseph E. Jeffries, Elwood, Ind.

ELECTRIC LIGHTING.

J. B. Canterburg of Sparta, Wis., is seeking an electric street railway franchise from the city council.

The Oliphant Suburban Traction company will build an electric line from Denmore to Oliphant, Pa.

The Tacoma, Wash., Electric Light & Water company's plant has been sold to the city for $1,750,000.

The Akron, O., & Silver Lake Railway company will begin the work of constructing its road in the spring.

Citizens of the South Side, Indianapolis, have petitioned the council for an electric street railway on Virginia avenue.

The Philadelphia & Delaware Street Railway company has been organized to build an electric line to North Chester from Philadelphia.

The Canon City, Colo., Electric Light & Power company has purchased $5,000 worth of new machinery and will double the capacity of the plant.

The sum of $30,000 will be raised in Fairfax county, Va., to aid in the construction of the proposed Alexandria City and suburban electric railway, projected by L. W. Spear.

An English syndicate, with headquarters at Montreal, has purchased a controlling interest in the Ottawa Gas company and Ottawa Electric Arc Light company for $500,000.

The Windemere Hotel at Chicago will have an isolated electric lighting plant, consisting of two generators manufactured by the Waddell-Entz company of New York. One of these machines will have a capacity of 30 kilowatts and the other 50 kilowatts.

The annual meeting of the stockholders of the Brush Electric company was held at Cleveland, March 21st. The following named officers were elected for the ensuing year: W. H. Lawrence, president; John S. Bartlett, first vice-president; C. A. Coffin, second vice-president; S. M. Hamill, secretary and general manager; W. B. Bolton, general counsel; B. F. Miles, treasurer; A. H. Hough, assistant treasurer; L. B. LeVake, assistant secretary; J. F. Hughes, auditor.

ELECTRIC RAILWAYS.

The Chippewa Falls electric street car lines are to be extended to Eau Claire, Wis.

Oakland, Cal., is contemplating giving franchises for the construction of another electric railway line.

The citizens of Waterport, N. Y., are co-operating with those of Albion with a view of constructing an electric railroad to connect the towns. F. E. Sickels of the Oak Orchard Improvement company, Buffalo, N. Y., is promoting the plan.

The Indiana Electric Power company has been granted a franchise to construct and operate a street railway within the limits of Goshen, Ind. The company also intends to connect the towns of Napanee and Elkhart with the county seat by independent lines.

Albert C. Wall of East Orange, Myles Tierney of New York and Theophilus Butts of Hoboken are the incorporators of the Hudson & Bergen Traction company, which filed certificates of incorporation with the Hudson county clerk in Jersey City and with the secretary of state in Trenton last week. The capital stock is fixed at $5,000,000, of which $25,000 was deposited with the secretary of state under the general law approved March 4, 1893. The company proposes to operate trolley roads from Jersey City to Rutherford, Hackensack, Englewood, Paterson, and the Oranges. The lines of the company will connect with those of the North Hudson Railway company, and it will compete with the New Jersey Traction company.

The new Suburban Traction company of Orange, N. Y., closed its deal with the Orange Cross Town & Bloomfield Street Railway company on March 18th for the purchase of the latter's road for operation by electricity. In addition to the proposed lines of this company, it has now before the East Orange township committee a petition for another franchise for a route from the present line through Prospect street, Marcy avenue, North Clinton street, South Clinton street, Railroad avenue and Amherst street, to the proposed line in Munn avenue, thus making a continuous line running through the township north and south. This company has a capital of $1,000,000, and, it is said will be incorporated in a few days. The promoters say that they will not accept, and have not yet received any offer from the Consolidated Traction company, which is buying up roads in the state with a view to extending, branching and interlinking them indefinitely.

TELEGRAPH

The annual meeting of stockholders in the Commercial Cable company was held at New York on March 29th. The following named directors were re-elected: [illegible], A. B. Chandler, G. S. Coe, C. R. Hosmer, J. G. Moreland, R. Irvin, Jr., J. W. Mackay, J. W. Mackay, Jr., E. C. Platt, T. Skinner, Sir A. D. Smith, W. C. Van Horne and G. C. Ward. The annual report showed that the gross earnings for the year 1892 amounted to $1,599,377, an increase of $14,263 over the net revenue as compared with the year 1891. Quarterly dividends of 1¾ per cent each have been paid, absorbing $540,120 and debenture bonds to the amount of $600,000 were redeemed on January 15th last, thereby reducing the total amount of bonds outstanding to $400,000. In order to provide for the laying down of a third cable it has been decided to offer to the shareholders for subscription at par 19,290 shares out of the 22,340 shares now unissued. Each shareholder will be entitled to subscribe for one share for every four shares he holds.

MISCELLANEOUS.

A portable electric light for use in night search for wounded soldiers is being tried in Berlin. A 50-candle power lamp is operated by a storage battery weighing 17½ pounds.

Thomas A. Edison, replying to the inquiry of the Toronto *Globe* as to the practicability of transmitting to the city of Toronto, by means of a cable across Lake Ontario, power generated at Niagara Falls, expresses the following opinion: "The laying of a power cable under water is the only practical method of accomplishing what you desire, for the reason that an aerial line would be affected by lightning. It is perfectly practical to convey 20,000 or 30,000 horse power to Toronto from Niagara by submarine cable. The following questions occur to me, however, in this connection: (1) Would not such a cable as the one proposed be liable to be disturbed by ship anchors? (2) Is the project commercial, and if effected could it compete with a quadruple expansion engine, with automatically stoked boilers, situated in Toronto itself? My impression is that the last named method would be the more commercial, notwithstanding the high price of coal in Toronto."

TRADE NEWS.

The Massachusetts Electrical Engineering company of Boston has established a department in which materials and apparatus in electrical construction are tested.

Waterhouse, Gamble & Co. have removed their principal office from 45 Broadway, New York, to their factory at Hartford, Conn. This firm reports large sales for its arc lamps.

The Weston Electrical Instrument company of Newark, N. J., manufacturers of the Weston ammeters, has an order on hand for a 25,000 ampere meter, which, when completed, will be the largest one ever made.

The Ball Engine company, Erie, Pa., will furnish four 150 horse power engines for the electric plant of the Mackaye Spectatorium, which is to be one of the most unique and interesting features of the Columbian exposition.

C. O. Baker, Jr., well known in the electrical field, has gone to London on business for the firm of Baker & Co. of Newark, N. J., the well known platinum dealers. While abroad he will also visit several other cities of importance in England.

The Crocker-Wheeler company of New York will soon move into its own factory at Ampere, (East Orange), N. J., and all business transactions will after that time be made at the general offices to be located at 39 and 41 Cortlandt street, New York.

The Fibrone Terraloid company of Newark, N. J., presents to the trade neat little paper weights made from its fibrone, for electrical fittings, which it claims will answer the same purpose as hard rubber and is much cheaper. It reports many sales for this new merchandise.

The J. T. Case Engine company of New Britain, Conn., is sending its patrons a tasteful little folder, descriptive of its automatic high speed engines, which have become quite well known through their simplicity, compactness, direct action and automatic lubrication. The company is very busy filling orders for its engines for immediate shipment.

I. L. Faucett, Quincy, Ill., manufacturer of the "Vacuum" Exhaust Steam Condensing Head, has issued a price list that will be of interest to the trade. This invention consists of an improved method of condensing exhaust steam and trapping the water back to a tank, open heater or some space where it can be used as a boiler feed or for other purposes.

Dr. Wellington Adams, general manager of the Chicago & St. Louis Railroad company, was in Boston recently arranging the details of electrical equipment for his new line, and during the burning of Tremont Temple was a guest at the Parker House. He told a reporter that it was the good work of the hotel people that prevented a much larger conflagration. Dr. Adams says that the unbelievers in his project have made themselves less conspicuous since the stock of the company has met with such successful sales, and the contracts for the entire track construction have been awarded to well-known firms.

The Jenney Electric Motor company, Indianapolis, Ind., has received many flattering testimonials as to the excellence of its machinery. A few years ago the company installed for King & Co., Indianapolis, a compound wound

dynamo, which has since furnished current for 800 16 candle power high grade incandescent lamps, 12½ horse power fan motors, 6 arc lamps, and one 10 horse power Jenney motor. The motor is run from 12 to 18 hours daily and performs its work in the most satisfactory manner, as a testimonial from the company indicates. Other evidences of the high class of motors the Jenney company turns out are constantly being received.

BUSINESS.

Sargent & Lundy, Monadnock building, Chicago, have been appointed western agents for the J. T. Case Engine company of New Britain, Conn. These engines are in extended use and have an excellent reputation. They are especially adapted for direct connection and a large business will unquestionably be done with them in the West.

The Electrical Appliance company of Chicago, Ill., has issued a catalogue of electric and combination fixtures and fixture accessories, and is making a specialty of this department in its business. The catalogue shows a complete line of medium priced fixtures, and the Electric Appliance company proposes, by making its line not over-extensive, to make up standard fixtures in quantities and reduce the cost materially to the trade.

The Delaware Hard Fiber company of Wilmington, Del., has just issued a card calling the attention of electrical manufacturers to the fact that the low prices which prevail for fiber have tempted some manufacturers of that material to introduce impurities in their goods. The company alleges that this can be done in the same way that rubber goods are adulterated. Its samples which have recently been examined they claim to have found large percentages of red clay and chloride of zinc and calcium. In one case nearly 50 per cent. of the "fiber" was composed of these impurities. The presence of such ingredients makes the fiber brittle, easily split, and causes it to swell and shrink under atmospheric changes, besides utterly destroying its insulating properties. Such material is wholly unfit for electrical work.

Word has been received from O. W. Russell, of the Link Belt Machinery company, Chicago, to the effect that his company has just furnished the Milwaukee Street Railway company, for the new power house at Milwaukee, a complete system of coal and ash handling machinery. By the aid of this machinery coal will be taken from wagons and delivered upon the street side of the building or from barges at the river side of the building, conveying it from either point to a system of coal bunkers extending from the first floor to the ceiling of the third floor. From these bunkers the coal may be drawn to any one of the nine boilers located on either the first or second floor. The ash device is designed to receive the ashes from any one of the eighteen boilers, delivering them to either one of two storage bins, from which they may be drawn into carts or barges. This is the most extensive system of coal and ash handling machinery erected in the West and is in keeping with the magnificent new power plant of this company in Milwaukee.

According to reports of some of the recent projects in Belgium and France, the proposed electric road between Chicago and St. Louis will be outdone considerably in point of speed. The Belgian government has recently given its support to a project for a passenger line between Amsterdam and Antwerp to run at a speed of not less than 150 miles an hour. It was scarcely more than a year ago when Dr. Wellington Adams, the father of the Chicago and St. Louis electric railway project, proposed before the New York Electric club what was then considered by some as a daring project. At that time such a thing as a multiphase motor for electric railway work had hardly been given a thought to this country. It should be said to the credit of Germany that in that country a multiphase motor had been used with some success at that time, and to a German manufacturing company Dr. Adams turned for his first equipment. Since that time the General Electric company and several other concerns have perfected similar motors, and have announced that they will contract for railway motors under a guarantee that they will travel at a speed of 100 miles an hour with perfect safety. Prof. F. B. Badt, of Chicago, has recently patented a number of multiphase railway motors for high-speed passenger railways. It is also interesting to note the attitude of Prof. Dolbear of Tuft's College, who thus speaks of the enterprise in a Boston magazine for February: "A 500 horse power motor can now be made as readily as a 500 horse power locomotive, and that the former can run safely two miles a minute there is no manner of doubt. It is altogether probable that within a year from this time electric trains will be run at this speed between Chicago and St. Louis, and with as great safety as with present express trains. The completion of that road will probably precipitate a rapid change of all railroad work. It should be remembered that the sudden adoption of such a new method, which renders useless the present appliances, would be ruinous to most roads in the country; nevertheless, the time may not be so distant when all locomotives will have to go to the dump, save here and there one in a museum, standing like an extinct mastodon."

The Calumet Electric Manufacturing & Engineering company of Chicago is the name of a recently incorporated concern that was organized for the purpose of manufacturing and trading in electrical machinery and doing general electrical engineering and repair work. The organizers of the company are Lucius A. Hine, president and secretary; George Edenson Dorman, vice-president and designer, and Lucius J. Otis, treasurer, with Charles T. Otis, Dr. H. H. Denning, Lucius A. Hine, Lucius J. Otis and George Edenson Dorman as directors. The Calumet Manufacturing company starts out in its business career with the management composed of men of large experience. Mr. Hine, the president of the company, has the advantage of an excellent technical education, having been graduated from the State University of Ohio with the degree of engineer of mines. Having during his college course paid especial attention to chemistry and mathematics as applied to physics and engineering, he was, after graduation, employed as chemist and assistant superintendent of a blast furnace company. He was next engaged to take charge of a corps of engineers surveying the lines for the Sandusky & Columbus Short Line Railway company. Until recently Mr. Hine occupied the chair of metallurgy, assaying and engineering in a western school of mines. Lucius J. Otis, the treasurer of the company, is man of more than average business ability and needs no introduction in the real estate and building circles of Chicago. Mr. Otis, however, has for a number of years paid particular attention to electrical matters and has devoted a large share of his leisure time to experimental electrical work and investigation. Mr. Dorman, the vice-president and designer of the company, has made for himself a record in Chicago through his excellent work for the Standard Electric company. Mr. Dorman designed the Standard arc light machines that are now operating at the "Fair" building, Chicago, and also designed the machines of the D. & D. Motor company, Minneapolis. He was trained as a mechanical engineer in England and made a thorough study of electrical engineering before coming to America. With three such men versed in both the business and technical departments of electrical manufacturing, the Calumet company starts its enterprise with every prospect of a successful career.

ELECTRICAL PATENTS.

Issued March 21, 1893.

493,629. Thermal Cut-out for Electric Lamps. Hermann Lemp and Merle J. Wightman, Hartford, Conn.

493,672. Automatic Electric Cut-out. Francis B. Badt, Chicago, Ill.

The cut-out is to be used in connection with lighting systems in which a gas engine drives a dynamo to charge a storage battery, and the cut-out is designed to automatically open the dynamo circuit when the battery is fully charged, and then cut off the supply to the engine. It is desirable to open the dynamo circuit in advance of cutting off the engine supply, as otherwise the battery would run the dynamo as a motor. As the back electromotive force of the battery gradually increases during the charging, a regulator is provided for the dynamo, which gradually increases the electromotive force of the dynamo to maintain the current constant. In shunt with the storage battery is placed an electromagnet of such resistance that it is not sufficiently excited to attract its armature until the battery is completely charged, at which time the electromotive force of the dynamo is maximum. The attraction of its armature by the magnet serves to close a circuit through a second magnet that acts to release a weight which first cuts off the engine supply and then opens the dynamo circuit.

493,673. System for Transmitting Electric Currents. Edward Baines, Brooklyn, N. Y.

The system is designed particularly for transmitting messages by the use of a common return, a number of transmitting and receiving instruments being included in separate circuit with sources of electricity, each having its return through a wire common to all.

493,678. Electric Railway Signal. Jefferson Bradford and James P. Williams, Boston Station, Ky.

493,679. Dynamo-electric Machine and Motor. Harold P. Brown, New York, N. Y.

The armature, instead of being wound with wire, is wound with flat bands or ribbons of copper, each convolution of which is separated from adjacent convolutions by a flat tape of asbestos paper or its equivalent, coated or impregnated with burnt shellac. The inventor has discovered that, by thus impregnating the asbestos paper with gum-like insulating material, an insulation is produced which is at once fire-proof, water-proof and not liable to permit perforation or jumping of the current through it when under high tension or when the apparatus is subjected to electric shocks. Shellac gum is well adapted for this purpose when first dissolved in alcohol, and afterward boiled or burned until the alcohol has evaporated. It is then applied to the asbestos while still hot, and the completed coil subjected to a high degree of heat.

493,695. Conduit Electric Railway. Henry P. Feltrow, Columbus, O.

493,704. Listening and Ringing Key for Telephone Switch-boards. William M. Goodridge, Highland Park, Ill.

Each plug of the operator's plug connectors is connected with a spring, which springs normally rest against contact points in electrical connection, whereby the two plugs are normally in electrical connection. A key is provided for each spring, by means of which it may be pressed away from its contact point to make connection with a back contact connected with the calling generator, so that each plug may be independently connected with the calling generator. A third spring is electrically connected with the two contact points, against which the plug springs normally rest, and makes contact with a terminal connected with the operator's telephone set, a key being provided for breaking this connection.

493,713. Insulator for Trolley Wires. Merrill H. Hathaway, Springfield, Mass., and John Kelleher, Manchester, N. H.

493,716. Conduit System for Electric Railways. Elias Hazelton, Lansing, Mich.

493,718. Dynamo-electric Machine. Santa Hellebrandt, Przemysl, Austria-Hungary.

493,719. Support for Phonograph Speaking Tubes or Other Purposes. William G. Henderson, Washington, D. C.

493,739. Electric Arc Lamp. Elihu Thomson, Lynn, Mass.

493,745. Dynamo-electric Machine. Force Bain, Chicago, Ill.

The armature core is built up from a number of dish-shaped plates, which are slipped on to the shaft and afterward straightened out so as to lie in one plane, whereby the plate is caused to grip the shaft.

493,754. Electric Connector and Cut-out. Charles H. Crockett and Chancellor C. Allen, Boston, Mass.

493,755. Electric Cut-out. Charles H. Crockett and Chancellor C. Allen, Boston, Mass.

493,777. Electric Clock Striking Mechanism. William Kaisling, Allegheny, Pa.

493,789. Trolley for Electric Railways. John F. Saitz, Baldwin, Pa.

Two trolley wheels ride upon the upper surface of the wire, and are secured to a frame from which is suspended a weight which maintains the wheels in contact with the wire at all times.

493,809. Apparatus for Purifying Liquors by Electrolysis. John Becker, Kymulga, Ala.

493,817. Secondary Battery. Lars Bristöl, London, Eng.

493,842. Electric Lighting System. Samuel W. Rushmore, Brooklyn, N. Y.

493,858. Transmission of Power. T. A. Edison, Llewellyn Park, N. J.

A pulley having a rim of magnetic material is provided with a peripheral groove extending around its face. Within this groove are wound a number of turns of wire included in an electric circuit. The passage of a current creates a north pole of that part of the metal upon one side of the peripheral groove, and a south pole of that upon the other side, so that the adhesion to the face of the pulley of an iron or steel rope or a leather belt carrying magnetic material is greatly increased.

493,868. Switch for Electric Light Fixtures. Joseph Hutchinson, New York, N. Y.

493,883. Insulating Coupling. Ernest Ballet, Bordeaux, France.

493,884. Rosette Cut-out. Charles E. Barry, New York, N. Y.

493,907. Telephone. Charles T. Bloomer, New York, N. Y.

493,914. Converter System for Railways. Alard du Bois-Reymond, Charlottenburg, Germany.

The system comprises sectional working conductors; two if the system be supplied with uniphase currents, three if it be supplied with triphase currents. The primaries of the converters are connected in series with the generator, the converters being located one at each section. The secondary of each converter is normally short-circuited by a cross connection between the two conductors, connecting the ends of the secondary coil with the sections of the working conductors. In one of the conductors is included a solenoid which, when excited, attracts its core to open this normal short-circuit. Thus when the car is not passing over the section the secondary coil is short-circuited, and the counter electromotive force is consequently a minimum, but as soon as the car passes upon the section the circuit is closed through the car, and the solenoid is excited to open the short-circuit and permit the passage of the current through the motor.

493,918. Electrically Operated Railway Switch. Powell Evans, Philadelphia, Pa.

Upon the trolley pole is carried a pair of contacts, which make contact with a pair of brushes supported from the same object as that from which the trolley wire is suspended. The brushes are connected with a pair of electro-magnets, stationed near the switch, one of the magnets being pivoted movably and connected with the movable portion of the track switch, so that its motion may operate the switch. The contacts upon the trolley pole are connected with a reversing switch upon the car, by means of which current may be sent through the electromagnets to actuate the switch.

493,926. Lightning Arrester. Hermann O. Henneberg, Berlin, Germany.

493,935. Electric Railway Signal. Henry V. Miller, Bloomington, and Alexander C. Miller, Aurora, Ill.

493,942. Electric Locomotive. Alexander Philipsborn, Berlin, Germany.

493,943. Electric Locomotive. Alexander Philipsborn, Berlin, Germany.

The motor supporting frame is connected at the rear with rigid bearings, in which turns the rear axle of the truck, while it has a free swinging connection with the front axle. Shouldered standards are mounted upon the supporting frame, the motor being sustained by the standards. Springs or buffers are interposed between the shoulders of the standards and the motor for the purpose of taking up shocks.

493,948. Closed Conduit for Electric Railways. George W. von Siemens, Berlin, Germany.

The working conductors are two in number, and are composed of a number of sections insulated from one another. Beneath the roadway in a closed conduit is pivoted an electromagnet in such a manner that it may oscillate transversely to the length of the track. Upon the car are carried two electromagnets, placed one at the front end and the other at the rear of the car, and situated in different planes parallel to the rails. As the car enters upon a section the foremost electro-magnet attracts the magnet pivoted in the closed conduit to move its end toward the plane of that magnet to connect the section with the supply conductor; when the hindmost magnet arrives opposite the pivoted magnet it moves it toward its plane to cut the section out of circuit.

493,969. Electric Car. Charles Brown, Basle, Switzerland.

493,997. Electrical Attachment for Rocking Chairs. Charles E. Hartelius, Bay Ridge, N. Y.

494,007. Block Signal System. John La Burt, New York, N. Y.

494,042. System of Winding Armatures for Dynamo-electric Machines. William M. Thomas, Grand Rapids, Mich.

494,053. Reciprocating Electric Drill. William A. G. Birkin, Nottingham, Eng.

494,062. Secondary Battery Electrode. William W. Donaldson and Roderick Macrae, Baltimore, Md.

494,077. Railway Block Signal. Robert D. Peters, Winamac, Ind.

494,091. Electric Cigar Lighter. William M. Thomas, Chicago, Ill.

494,098. Electrical Appliance. Charles H. Folger, Cincinnati, O.

494,111. Electrical Railway Signal. Samuel W. Miller and Alexander C. Miller, Aurora, and Henry V. Miller, Bloomington, Ill.

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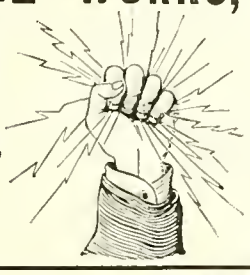

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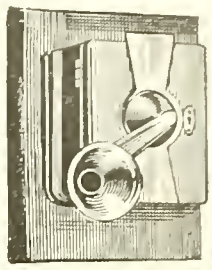

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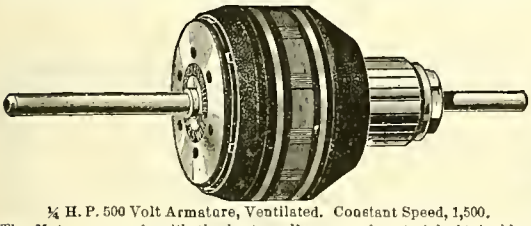

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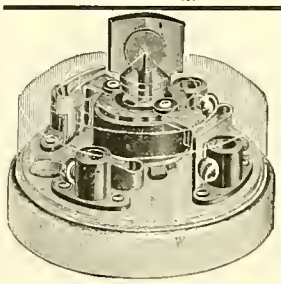

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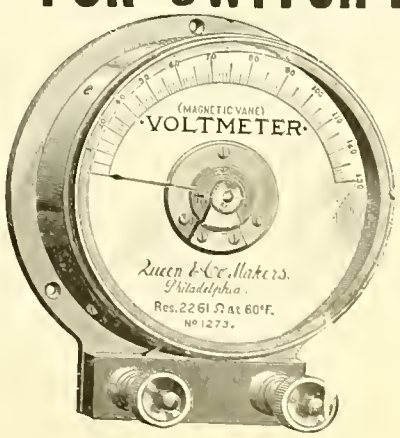

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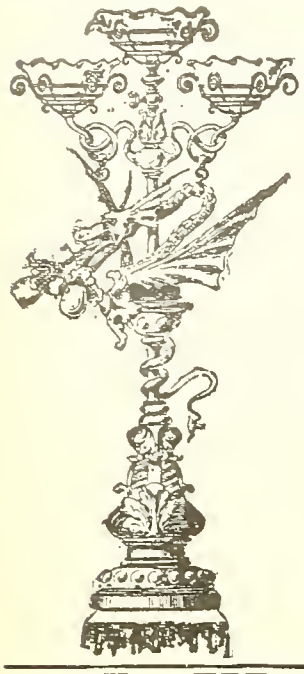

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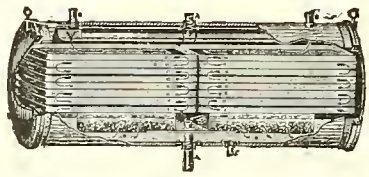

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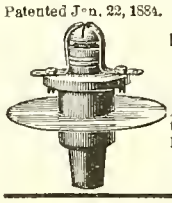

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At Milwaukee, Wisconsin.

Notice is hereby given that in pursuance of an order of the Circuit Court of Milwaukee County, Wisconsin, I will, on the 30th day of June A. D. 1893, at eleven o'clock in the forenoon of said day, at the south door of the Court House in the city and county of Milwaukee, Wisconsin, offer for sale and sell at public auction as an entirety, the street railway of the Milwaukee Electric Railway Company in said city of Milwaukee, with all the franchises and rights and privileges of said railway company for the operation and maintenance of the same, and all the property of said corporation used in or in connection with, or essential to the exercise of its said franchises.

Said railway property and franchises consist of about 6½ miles of double track, being about 13 miles of single track, in said city of Milwaukee, with all the poles, wires, cables, trucks, ties, stringers, fixtures and appliances composing or used in connection with said tracks or said railway, with franchises, privileges and rights derived from ordinances of the common council of the city of Milwaukee to maintain and operate said road; also sundry parcels of real estate in said city, with car barns and power house thereon; also the engines, boilers, machinery and rolling stock and supplies of said road.

The terms of such sale are cash.

The said street railway will be sold free of all liens and encumbrances except judgments of foreclosure and sales aggregating $21,193.-56, with interest from the 22d day of November, 1892, at 7 per cent. on $1,259.60 thereof, and at 6 per cent. per annum on the remainder. Said judgments of foreclosure covering the said specific parcels of real estate.

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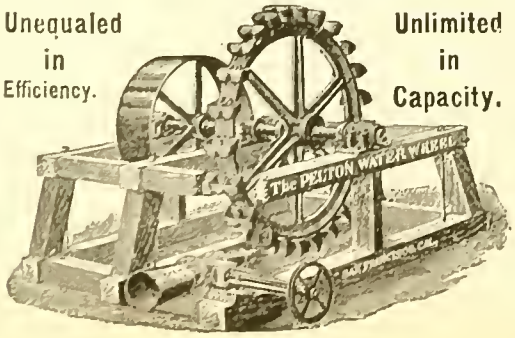

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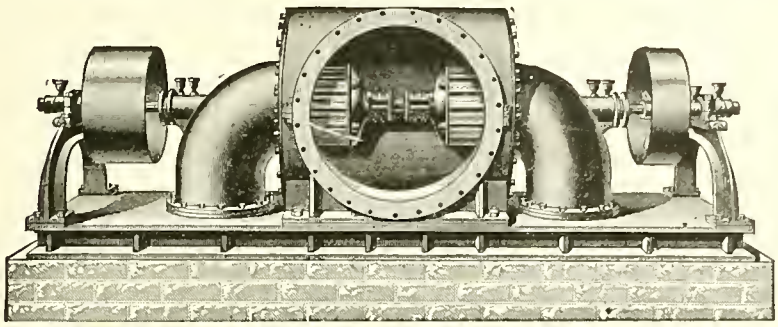

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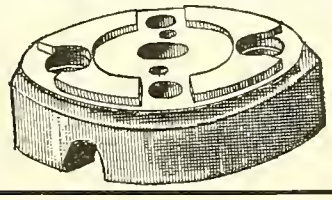

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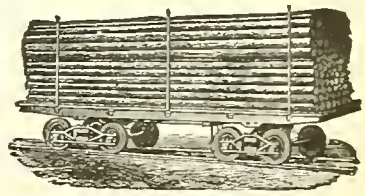

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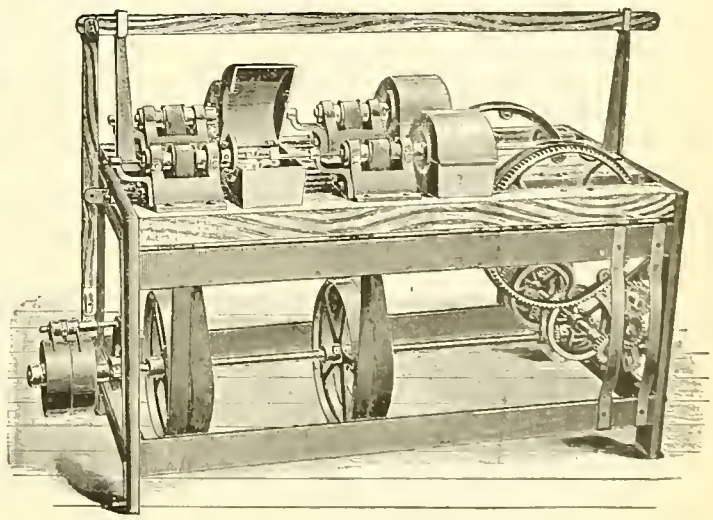

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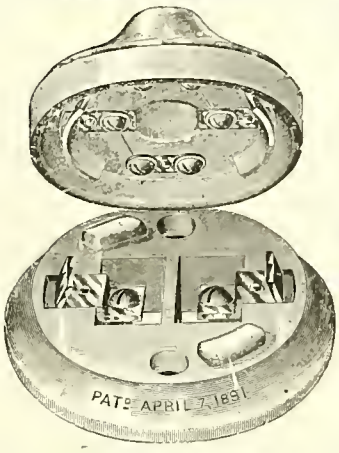

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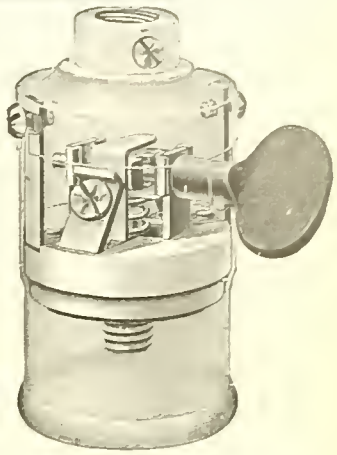

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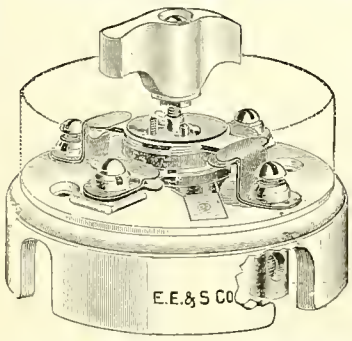

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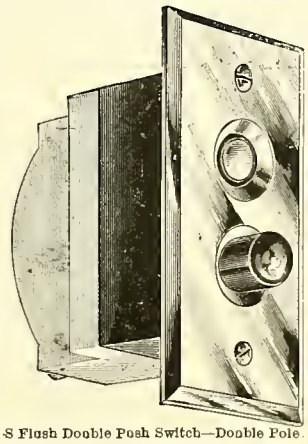

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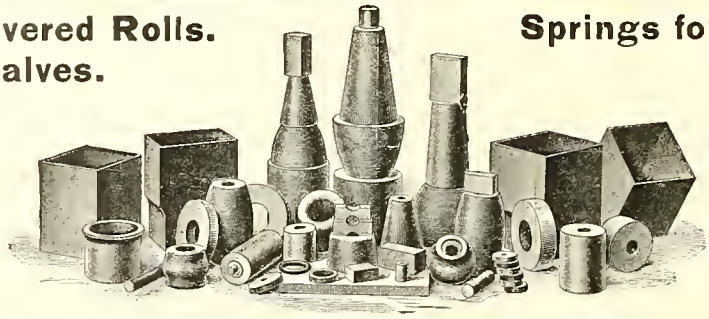

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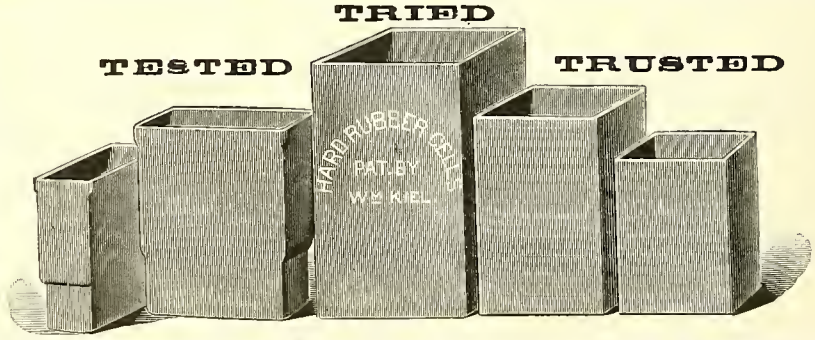

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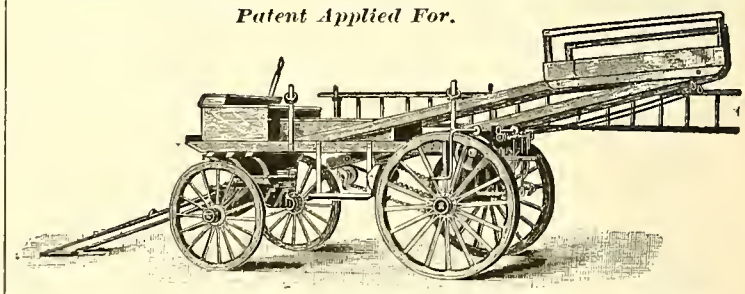

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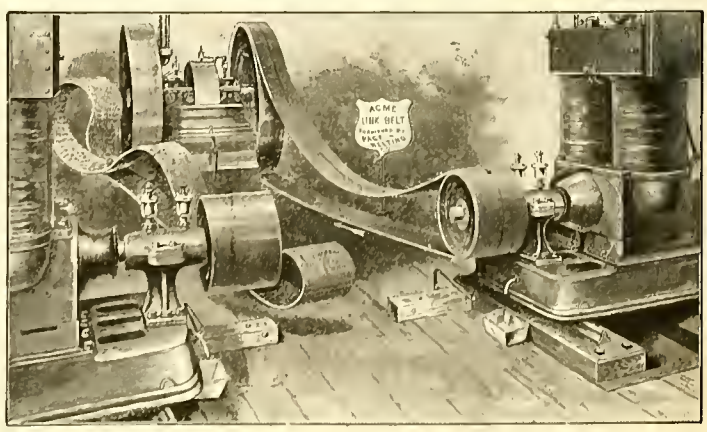

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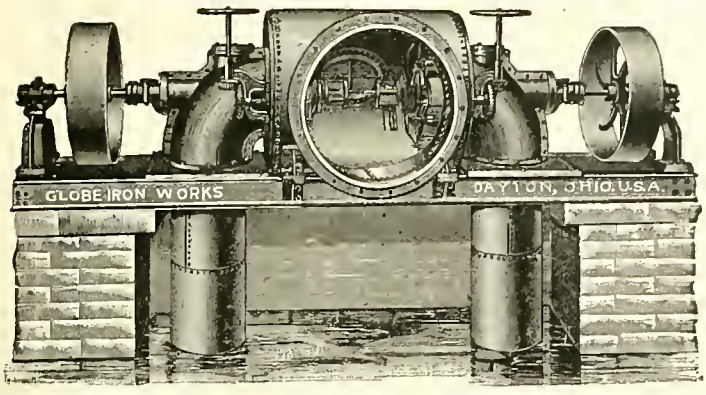

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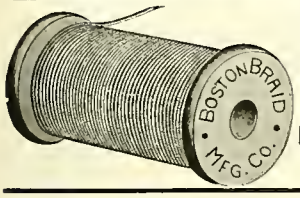

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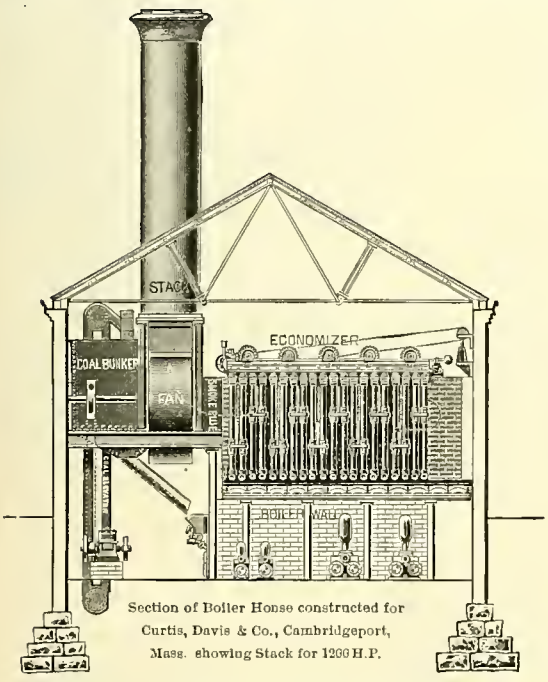

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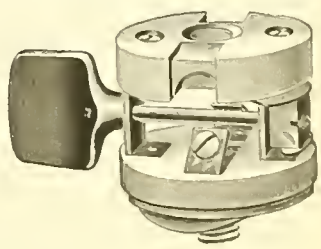

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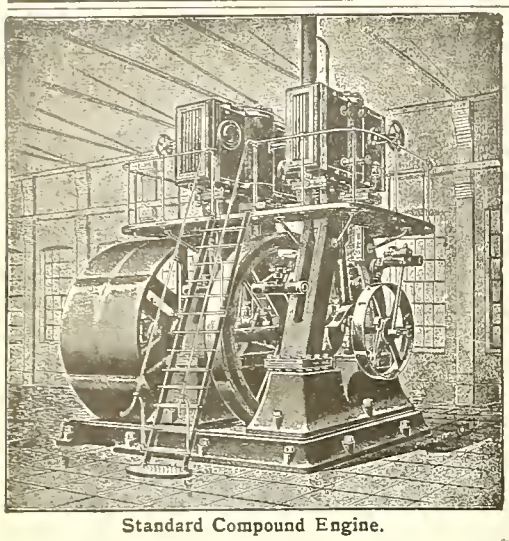

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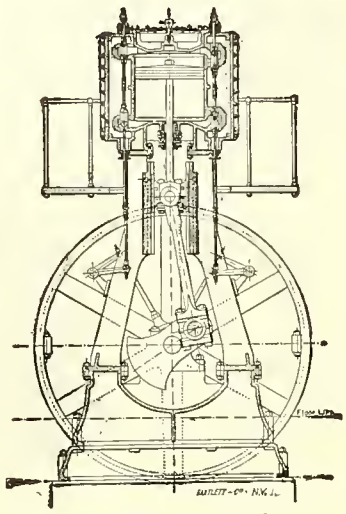

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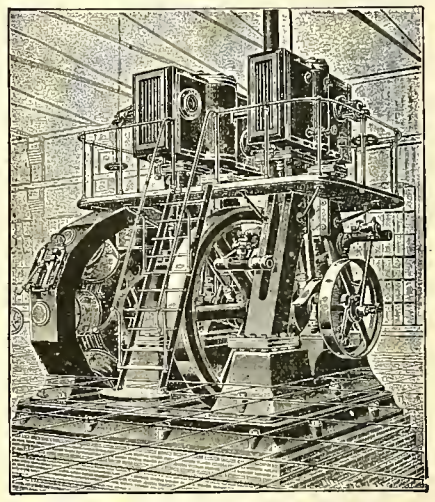

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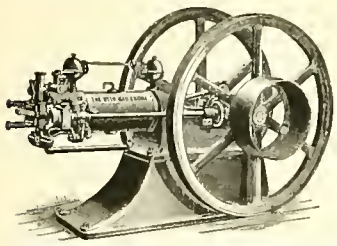

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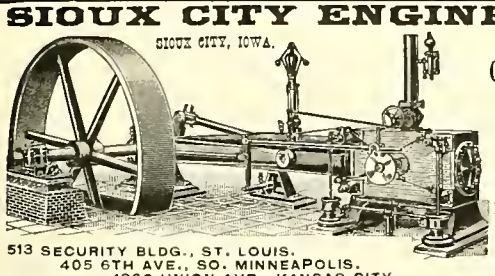
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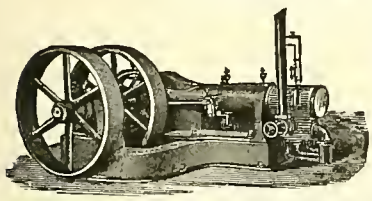
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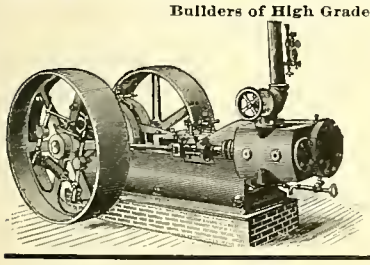
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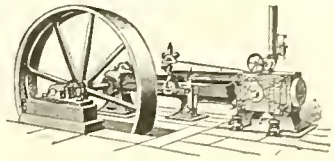
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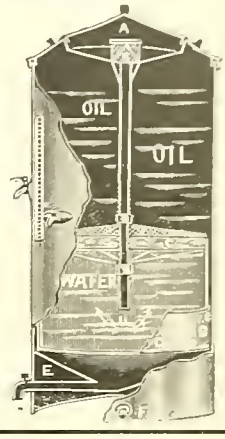

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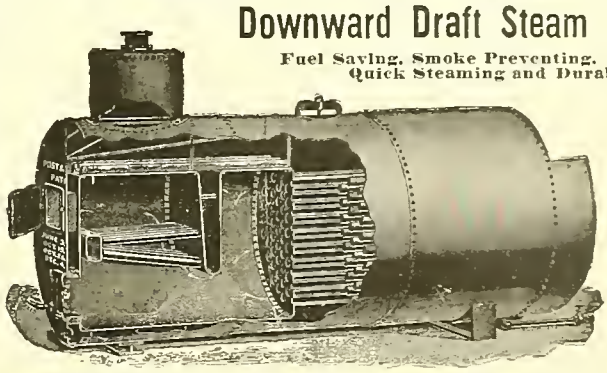
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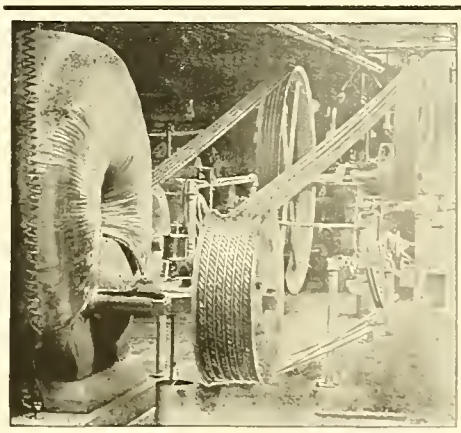
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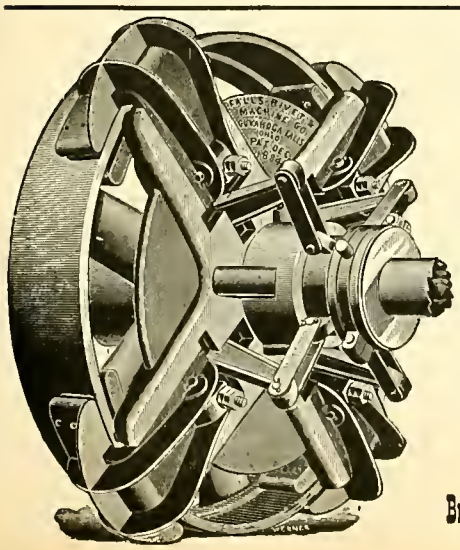
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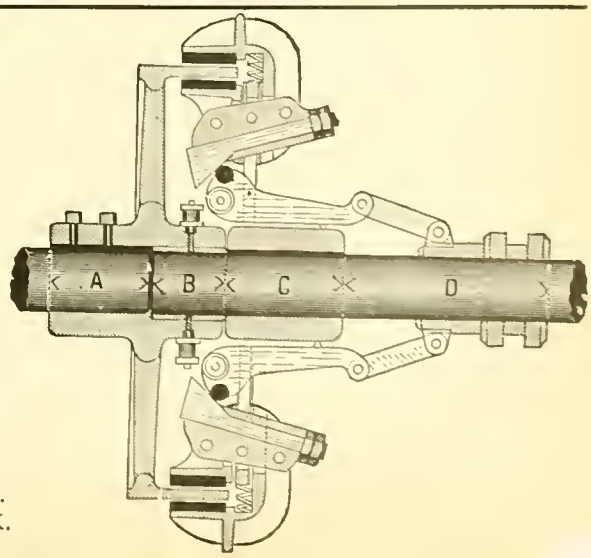

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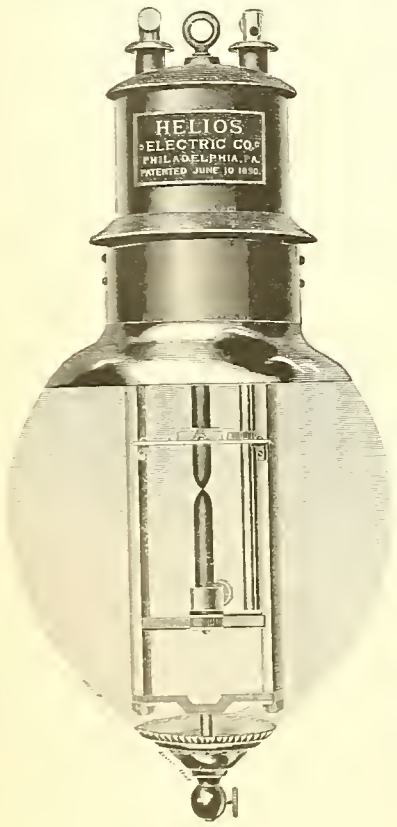

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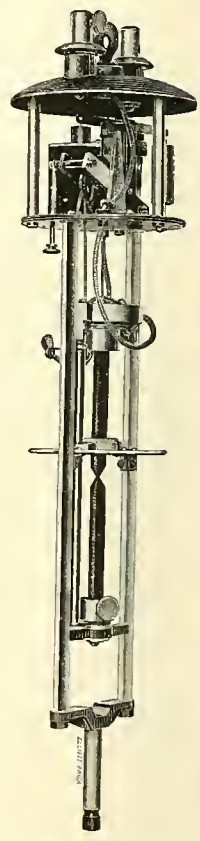

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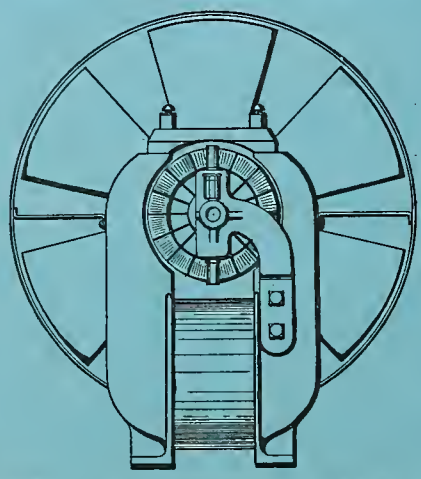

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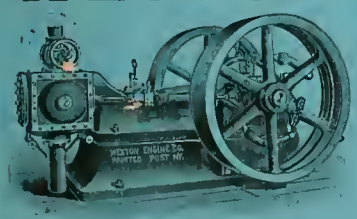

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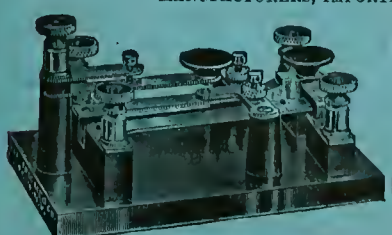

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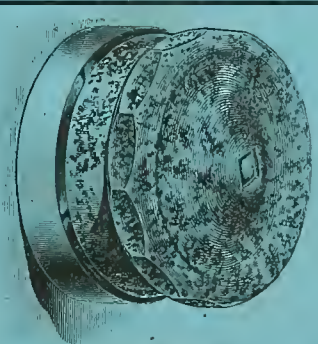

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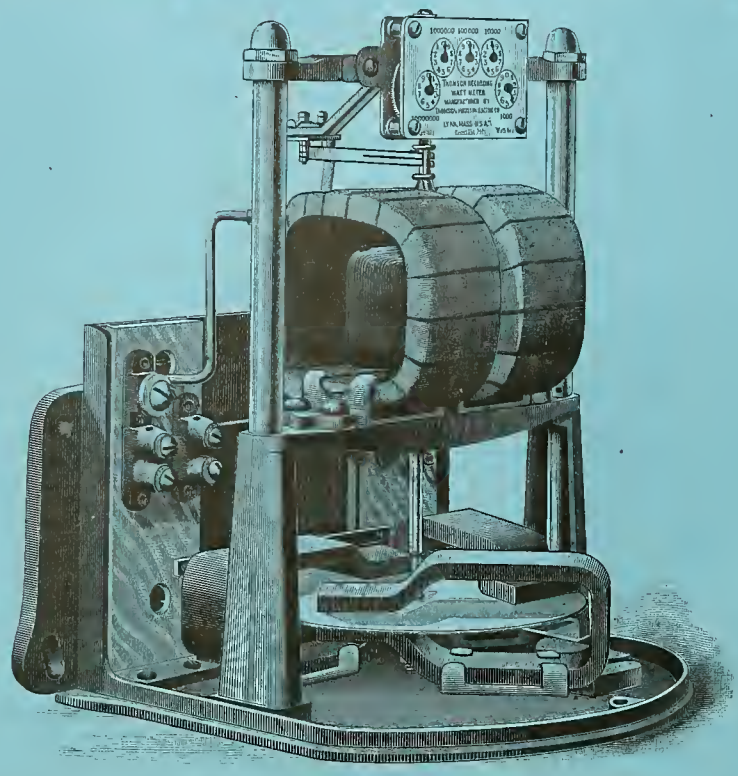

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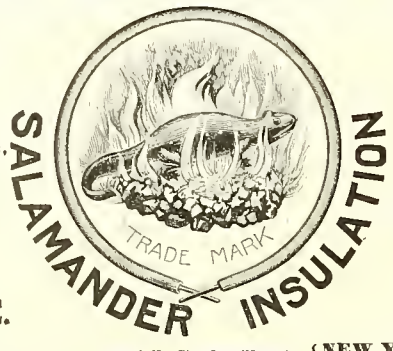

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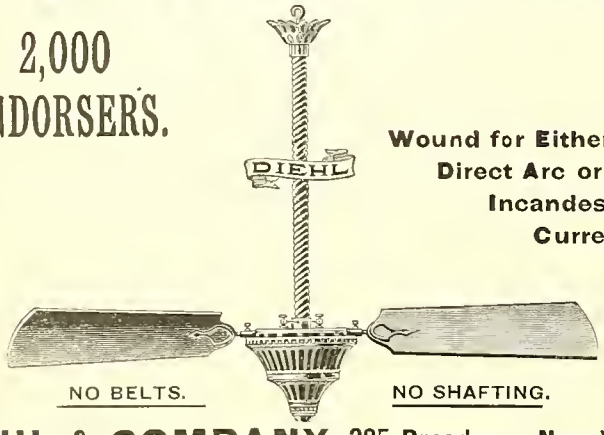

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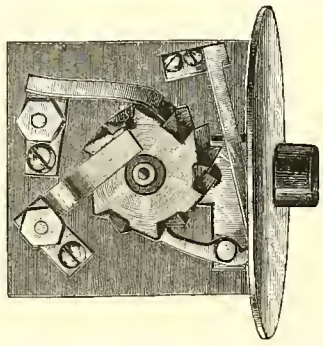

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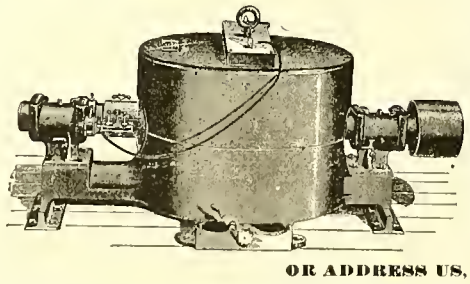

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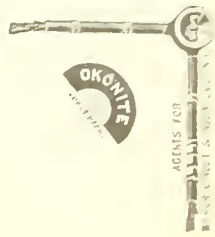

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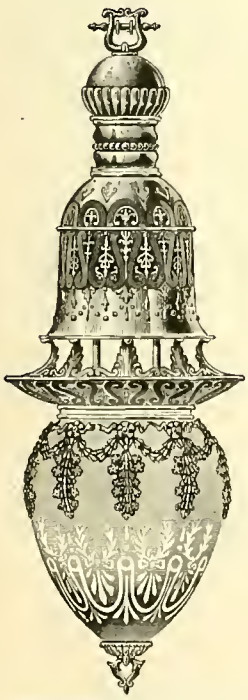

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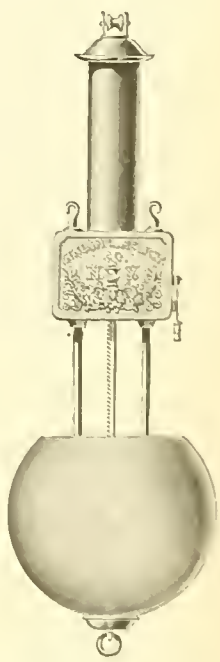

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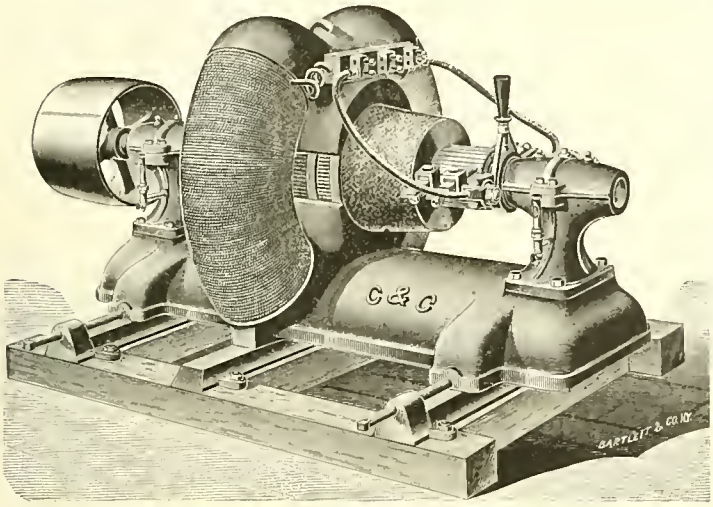

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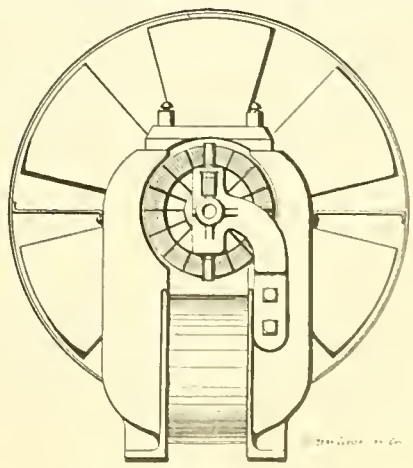

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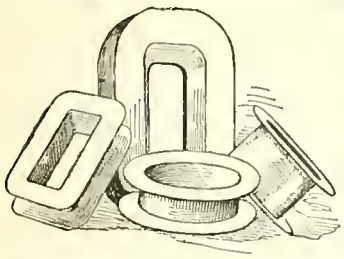

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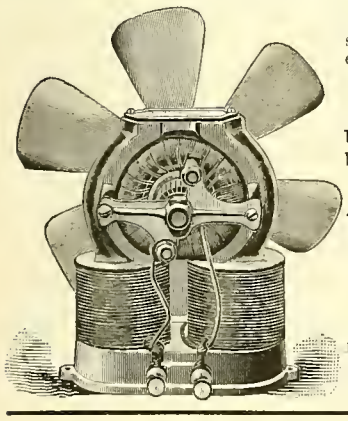

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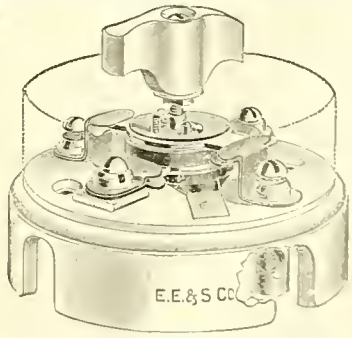

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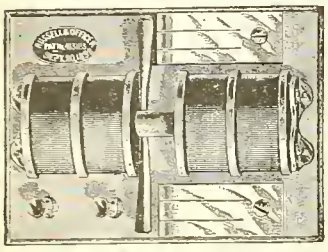

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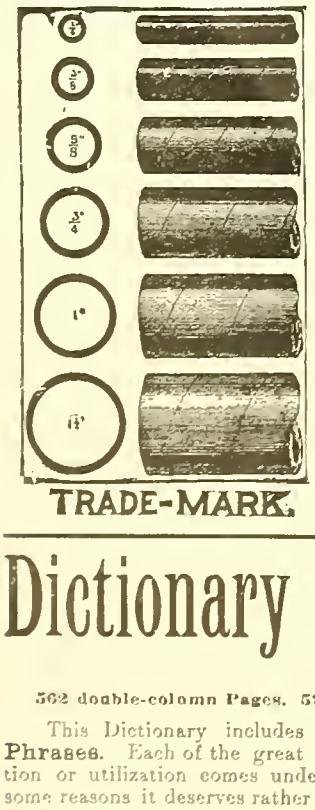

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BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. DENVER.

NOTICE.

January 27, 1893.

To the Electrical Trade:

I have this day assigned the entire interest in the Cleveland Switch, Patent No. 391,512, to THE BRYANT ELECTRIC COMPANY, of Bridgeport, Conn., together with the tools, patterns and moulds for making the Switches and Arc Cut-outs formerly manufactured and sold by THE FOREST CITY ELECTRIC WORKS, of Cleveland (Factory, Geneva, Ohio).

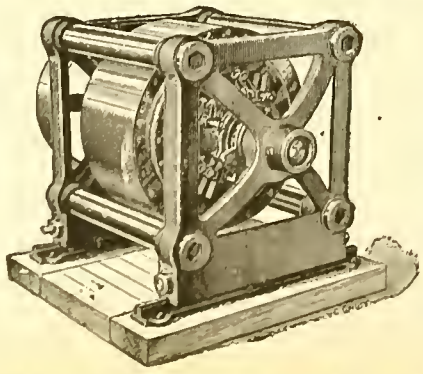
I trust that my former friends and patrons will extend to them the same good will and patronage that they have shown me in the past.

Very respectfully, (Signed) W. B. CLEVELAND.

THE BRYANT ELECTRIC CO. MAKES GOOD GOODS.

The WADDELL-ENTZ COMPANY,

203 BROADWAY, NEW YORK.



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WORKS AT BRIDGEPORT, CONN.

Western Electrician.

EVERY SATURDAY.

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Electricity at the World's Fair.

With the pleasant weather of last week the construction work at the World's Fair was pushed with redoubled energy. As the bright sunshine succeeded the dismal, rainy weather of the preceding weeks, so doubt has been replaced by confidence, and everybody is talking hopefully of completing the preliminary work by May 1st. This feeling pervades the electrical as well as all other departments, and it is now the general belief that the electrical display—exhibits, service plant, special features and all—will be ready on time. In the month that remains there is much to be done, but there is little doubt that when President Cleveland opens the fair the electric illumination of the grounds will only await the adjustment of valves and switches, the elevated trains will be running by electrical power, electric launches will be darting about the lagoons, electric fountains and great search-lights will simply await darkness to display their splendors, machinery will be humming by the impulse of electrically transmitted power, and the elaborate and beautiful display in the electricity building will be ready for inspection.

Activity is observable in every section of the electricity building, and the different exhibits are beginning to take shape. The exterior of the large and elaborate pavilion of the American Bell Telephone company is now completed, and a beautiful structure it is, as can be seen by referring to Fig. 1, which is a picture of the interior of the electricity building, taken, however, several days ago, before the finishing touches were put on the Bell pavilion. The fenced-off space in the foreground of the picture encloses a portion of the General Electric company's allotment, and it already contains a number of Thomson-Houston machines, from a big multipolar generator down to a tiny motor. The Westinghouse, Brush, Western Electric, Short, Fort Wayne and other big companies are hard at work, and preparations in the gallery, where the lighter exhibits will be shown, are also being rushed. The telephone pavilion, which will form so prominent a feature of the display, is directly in front of the spectator entering the southern portal of the building. It will contain booths for special telephone demonstrations and models of over 500 patents held by the company. The structure is 20 feet high, of Grecian architecture, with Corinthian columns and a dome 45 feet high, under which is to be an audience chamber in which long-distance telephonic concerts will be given.

FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.

By an agreement between the Phœnix Glass Works and the General Electric company the circular space in the center of the ground floor of electricity building—the tidbit of all space available for exhibitors, in fact—will be principally devoted to an Edison "tower of light." This space was originally awarded to the Phœnix Glass Works, and it was the intention to erect a beautiful glass pagoda, with lighting effects, but recent negotiations have resulted in an arrangement by which the General Electric company is building instead an Edison tower as a glorification of the Edison incandescent lamp. This tower will consist of a shaft rising eighty feet above the floor, with an open space or corridor beneath. The corridor will be taken up by the exhibit of the Phœnix Glass Works, while the column above will be ablaze with a myriad of decorative incandescent lamps, about 18,000 in all. The display will partake of the nature of a personal exhibit by Thomas A. Edison, and the design, which was prepared by Luther Stieringer, received Mr. Edison's approval. The framework is of wood, with a covering of staff. This "tower of light" will undoubtedly be the most conspicuous feature of the building at night.

The contract for charging the accumulators of the Electric Launch & Navigation company has been awarded to the General Electric company, which will erect a charging station for the launches on the platform on the southern and eastern sides of the agricultural annex, separating that building from the south pond. Slips will be built so that the batteries of 60 boats can be charged at once. Current will be supplied by the four 175 kilowatt Edison dynamos in machinery hall that until ten or eleven o'clock at night will

furnish light for the operation of the electric fountains. After the fountains are shut down the current will be switched into the mains leading to the charging station. Each slip will be provided with a switch-board, with ammeter, voltmeter, controlling rheostat, switches, fuses, etc. The accumulators on the launches will thus be charged every night for the work to be performed during the next day. It is believed that this will be the largest storage battery charging station in the world.

Last week the work of removing the engines and dynamos in the old temporary electric lighting and power station south of the transportation building was begun, and by Saturday night all the dynamos had been taken away. The Edison arc and incandescent dynamos and power generators were removed to the General Electric company's warehouse down town, the Standard arc machines were taken to machinery hall to form a portion of the permanent arc lighting plant and the Wood arc dynamo went to South Chicago. In a few days the building will be entirely demolished to make way for another structure that is to be erected on the site. This station has done excellent service and proved itself of great value during the period of construction operations. It was illustrated and described in the WESTERN ELECTRICIAN of October 10, 1891, November 7, 1891, and February 18, 1893.

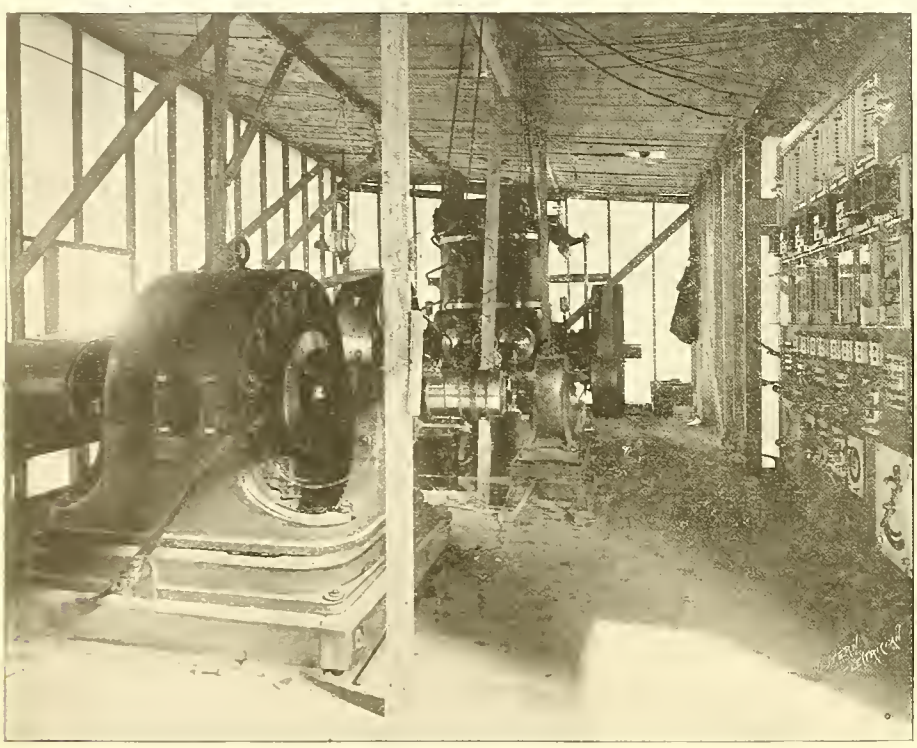


FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.

Taking the place of the old temporary plant for incandescent lighting, a portion of the permanent Westinghouse equipment, Fig. 2, is now in operation. It consists of two 400 horse Westinghouse compound engines, belted directly to two Westinghouse alternating current dynamos of 4,000 lights capacity each. The exciters are of the United States company's type. These machines and a temporary switch-board are enclosed in a temporary "station" in the Westinghouse space in machinery hall, and one end of the plant is shown in the picture. About 1,000 lamps are now supplied from this station, mostly in the service, photographic, mines, transportation and engineering buildings. All of these are the new Westinghouse lamps, except in the service building, where a number of Edison lamps are still burned. But few renewals have thus far been called for.

The installation of the permanent Westinghouse plant is proceeding very satisfactorily. The frame of the big switch-board is up, and the work of facing it with white marble is now in progress. All of the dynamos are on the ground, except two of the large machines, and these have been shipped from Pittsburg. The work of setting up the engines is also well under way. Two hand cranes of twenty tons' capacity each were erected over the Westinghouse space last week to convey the heavy castings to the places designed for them, as the nearest traveling crane does not pass over the spot. The outlook for the completion of the plant by May 1st is promising. Indeed, General Manager Keller is confident that unless there is some delay in the operation of the steam plant the incandescent equipment will be in full running order by the latter part of this month.

Six of the Brush machines in the service building are taking care of the temporary arc lighting since the abandonment of the old station. The circuits are still carried overhead on poles. Current has already been distributed through ducts for incandescent lighting, however, and within two weeks all the unsightly poles and wires will have become a thing of the past. The wiring for the power circuits is going on at a rapid rate under the direction of L. S. Boggs. Running from the northwestern corner of machinery hall sixteen No. 0000 wires will be strung along the elevated railway structure. Ten of these will supply power to the transportation building, which will require about 300 horse power; four will take current to the Midway Plaisance and two to the state and government buildings at the northern end of the park. In the west division of the subway there will be twelve No. 0000 wires for power, six going to the administration building and six to the mines building. In the east division four No. 0000 conductors will convey power to the government and fisheries buildings and four No. 000 to the manufactures building. From the southeastern corner of machinery hall twelve No. 0000 wires will be stretched on the elevated railway structure, six supplying the leather, dairy and agricultural buildings and the southeastern portion of the park, and six furnishing current to the motors operating the movable sidewalk on the pier. The generating plant will comprise four C. & C. 80 kilowatt 500 volt machines and two generators of the same type and capacity wound for 220 volts, four 200 kilowatt six-pole Eddy machines, four Mather multipolar generators of a combined capacity of 600 kilowatts and one Westinghouse multipolar generator of 500 horse power. Of these machines two 120 kilowatt Mather generators are now in operation.

To electrical engineers one of the most interesting features of the exposition will be the lighting scheme of the annex to the machinery building. It has been decided to light this building with arc lamps run from 500 volt constant potential circuits. The lamps will be furnished by the General Incandescent Arc Light company and will be wired ten in series. There will be 160 lamps in all, each of 2,000 nominal candle power. The plan has not yet been worked out in detail, but it is settled that the system will be given a trial. Arc lamps have been burned on street railway circuits before, but it is believed that this is the first attempt to light a building on a large scale in this manner.

In answer to the complaint of the holders of concessions in the Midway Plaisance, that an insufficient number of arc lamps to light their displays was obtainable from the exposition authorities, it is announced that a number of alternating arc lamps, supplied from incandescent circuits will be provided in that portion of the grounds.

In the permanent electric lighting plant in machinery hall a telephone will be installed at which a boy will be in attendance day and night. This telephone will be devoted to the transmission of complaints of lamps not burning, especially arc lamps used for patrol lighting. Arrangements will be made so that a lineman can be promptly despatched to remedy the difficulty in each case.

Work on the Stirling boilers in the steam plant at machinery hall is proceeding rapidly, and the battery will be ready for firing in a week or two. To supply the demand for additional steam capacity another battery of Heine boilers and two Climax boilers will be placed in the supplementary boiler house adjoining the machinery annex. Regarding its difficulty with the Temporary Boiler association over the World's Fair allotment the Stirling company says:

Additional space was created, which the Stirling company applied for on equal terms with all, but was refused, the engineer in charge stating that the space had been promised to the Babcock & Wilcox company. The Stirling company appealed to the council of administration, was sustained and contract entered into. After many ineffectual efforts to change this decision, the Babcock & Wilcox company filed a bill for an injunction to shut out the Stirling boilers, thus seeking to create a monopoly. The master in chancery decided in favor of the Babcock & Wilcox company, but Judge Grosscup of the United States District Court set this decision aside, stating that the World's Fair engineer had no authority to make a verbal agreement. The judge held that the Babcock & Wilcox company failed to establish any one of the essential allegations of its bill, and the injunction prayed for was denied with costs against the complainant. Judge Grosscup emphatically stated that the bill was evidently filed for the purpose of excluding Stirling boilers as an exhibit; and the evidence in the case and all the circumstances show clearly that the object of the Babcock & Wilcox company in filing the bill was to prevent an exhibit of the Stirling boilers along side of and in close comparison with the Babcock & Wilcox boilers.

The American Institute of Electrical Engineers has secured two pleasant rooms on the second floor of the electricity building facing the hemicycle and adjoining the offices of the department of electricity. These headquarters are now being furnished, and the secretary of the institute, Ralph W. Pope, will be in general charge during the exhibition. The committee of ways and means extends an invitation, not only to the members of the Institute, but to all foreign members of the electrical profession who may visit the World's Fair, to use these rooms as their headquarters. Letters may be addressed in the care of the secretary at the headquarters, and in the furnishing of the rooms facilities will be given for writing letters, meeting friends, reading technical papers, which will be placed on file, leaving parcels and securing general information upon the electrical congress and World's Fair matters generally. The rooms will be equipped with a long-distance telephone and telegraph service, fire protection, and the authorities have promised to place one or more members of the Columbian Guard at the headquarters. The Institute has decided to place in these rooms various objects of scientific and historical interest, such as photographs, pictures, autograph letters, rare electrical books, models, instruments, etc. These things will be properly classified and arranged, and the committee requests all persons having objects which would prove of interest in this connection to communicate with Mr. Pope at the headquarters of the Institute, 12 West Thirty-first street, New York city, or with the chairman of the committee, William J. Hammer, 527 Temple Court, New York city. As space is limited, the committee will be compelled to select only objects which are not too bulky and which are of great interest and value. The committee trusts that a prompt response will be given to this call, and that all the members of the Institute will feel a personal interest in seeing that the exhibit made shall be as full and as valuable as possible. The secretary was instructed by the council at the last meeting to extend an official invitation to the foreign electrical societies to avail themselves of the privileges of the Institute.

Trial of the Wheless Conduit Railway System at Washington.

A public trial of the Wheless conduit system for street railways was made at Washington, D. C., March 29th, and according to the daily papers the projectors of the system and the railroad officials who witnessed the test pronounced it satisfactory in every respect. A portion of the Washington and Arlington railroad, about three-fourths of a mile long, had been equipped with the Wheless system. It is the intention of the company to equip that portion of the road between Georgetown and the Baltimore and Potomac depot in Washington. The conduit upon which the trial was made was built by Pepper & Register of Philadelphia, under designs of William Chapman. The system used is the invention of Malone Wheless.

A bill has been passed authorizing Ashtabula, O., to issue electric light bonds to the amount of $15,000.

An Invention Without Commercial Value.

By C. D. Haskins.

Not long ago two gentlemen, one of whom is engaged in teaching the science of electricity and the other occupied in making practical applications of the science, were discussing kindred topics when they touched upon the subject of recent developments in multiplex telegraphy. The practical man had just described one of Gerritt Smith's numerous quadruplex devices, which makes it possible to transmit different messages to each of two sounders at the same time by means of a polarized relay, having a single horse shoe electro-magnet and only one armature, when the theoretical man, to express his appreciation of Mr. Smith's ingenuity, suggested that, Mr. Smith being able to "wiggle" only one armature and thereby make each of two sounders simultaneously deliver a different message, it would be but little more wonderful if it were possible to devise a method whereby a simple piece of twine stretched between two rooms would enable Jack in room A to to send "Morse" to Jim in room B by agitating the string, while, at the same time, Bob in room B by similar agitation of the same string was sending "Morse" to Bill in room A, thus duplexing the capacity of a string to convey "jerked" signals between distant points.

Upon this suggestion the practical man, after a moment's reflection, said: "Well, a string can be duplexed, and here is a way to do it." Then he drew a diagram showing a perfect working "duplex," which is herewith reproduced as a singular illustration of the fact that a really ingenious and scientific invention may be absolutely of no commercial value.

In the diagram P and P' are contact points, M a pin through the key rod limiting the upward movement, X and X' whiffletree levers on key rods A and A', B and B' supports and guides for key rods, Z fulcrums of the levers, E strings connecting the system of levers.

Referring to the diagram, it is obvious that any upward or downward motion of Jack's sending key in room A will not effect the relative distance between the contact points at P, but will respectively open and close contact points at P', in room B, regardless of the position or movement of Bob's key. Again it is true that the working of Bob's key will not affect the relative positions of contact points at P' but will reproduce Bob's signals at P. Thus we have the following key system:

When both keys are depressed simultaneously, the string remains stationary, but both at P and P' the contact points are closed.

When both keys simultaneously move upward, the string remains stationary, but contacts at both P and P' are opened.

When the key in room A only is depressed, the string moves to the left and the contact points at P' in room B are closed.

When the key in room A moves upward the string moves toward the right, and contact points at P' are opened. When the key in room B is depressed, the string moves toward the right and the contact points at P are closed.

When the key in room B moves upward, the contact points at P are separated, while the string moves toward the left.

It will be observed that the spiral springs—one at the left in room A, and the one at the right in room B—must be stronger than their opposing springs to compensate for the strain and weight of the string line. Is it not possible for some reader to find useful application of the principles involved in this curious device?

Electrical Congresses.

It must be admitted, says *Electricity* of London, in speaking of the coming World's Electrical Congress, that no better place and no fitter occasion could have been chosen for such a gathering than will be presented by Chicago during the time of the exhibition. It will be of interest to note that all previous international electrical congresses have been held in connection with universal or electrical exhibitions, and this is, no doubt, due to a desire on the part of the organizers of the congress to afford to the members practical illustrations on the largest possible scale of the science of applied elecricity, which could hardly be said to have existed twenty years ago. The Paris Electrical Exhibition of 1881 came as a surprise even upon the most prominent electricians of the time; very few among them knew what a dynamo, an arc or glow lamp or a telephone meant, and a fortnight spent in Paris taught them more than the protracted study of years. The achievements of this exhibition were of a two-fold character. In the first instance, it demonstrated the practicability of electric lighting; and, secondly, it placed applied electricity on a thoroughly scientific basis, by supplying it with units of measurements, such as the volt, the ohm, the ampere and the farad.

Subsequent exhibitions and congresses cannot boast of such remarkable achievements, although they all contributed their share toward popularizing the new electrical appliances and spreading electric knowledge. They each introduced some typical and marked improvements to public notice. The Paris Exhibition of 1881 gave us electric light, the Munich Exhibition of 1882 produced the first experiments on a large scale of distinct power transmission, the Vienna Exhibition of 1883 showed us the first shunt and compound wound dynamos, and the Frankfort Exhibition of 1891 brought us the practical realization of one of the greatest projects ever conceived—electrical power transmission over a distance of more than 100 miles. The two last electric congresses, however—the one in Paris, in connection with the exhibition of 1889, and that in Frankfort in 1891—produced very little result. The programme of the former congress was one of the most elaborate and most ambitious documents we have ever seen in print, and when the congress was over it was found that not one-twentieth part of the topics proposed for discussion had ever been approached. If the congress, instead of lasting for 10 days, had been prolonged for 10 weeks, they could not have gone through half of the programme. The Frankfort congress was simply made the occasion for the reading of some highly interesting papers, but in its results was as fruitless as the Paris one of 1889. The programme of the Chicago congress now before us is certainly most promising, and holds out hopes of vast improvement in the nomenclature and definition of electrical units and terms, but we are afraid that it is too large a programme, and that a week is not nearly sufficient to arrive at a practical result.

The Future Ohm, Ampere and Volt.[1]

By Henry S. Carhart.

Since the International Congress of Electricians in Paris in 1881 the most eminent physicists have been agreed as to the theoretical values to be assigned to the three fundamental units of electrical measurement; but it has been a matter of ten years' labor on the part of many distinguished investigators to embody these theoretical definitions in practical units for universal use.

Up to the date mentioned the two units of resistance in use were the British Association (B. A.) unit and the Siemens unit. Only the former represented an attempt to construct an ohm corresponding to the theoretical definition. The B.A unit has served a useful purpose, but it is now known to be 1.34 per cent. too small.

The "legal ohm" was provisionally adopted in 1884 by an international committee to which the Congress of 1881 had committed the subject. It was in the nature of a compromise, and fixed the practical ohm as the resistance at 0° C. of a column of mercury one square millimeter in cross-section and 106 centimeters long. Competent investigators, like Lord Rayleigh and Professor Mascart, contended that a column 106 3 centimeters in length was nearer the true value; but a few smaller values obtained by some well-known physicists decided the adoption of the mean value 106 centimeters. This conclusion satisfied no one, and the "legal ohm" was never legally or officially adopted by any European or American government.

Subsequently, Professor Rowland came forward with his determination of 106.32, and errors were found in the data of some who had contended for the lower values. Hence the number 106.3 has been tacitly accepted for two or three years already, and it is now believed that this does not differ from the true value by more than two units in the fifth figure; that is, the length of the mercurial column representing the true ohm is not less than 106.28 and not more than 106.32 centimeters.

Somewhat over two years ago a commission was appointed by the British Board of Trade to draft an "order in council" as a legal settlement of the units to be employed by the Board of Trade Electrical Bureau, and hence as the legal electrical units for Great Britain. After the committee had made its report, but before the "order in council" had been signed by the queen, an intimation was received from Professor von Helmholtz that something might be done toward international agreement if the order were delayed till he could communicate in person the results of the most recent determinations in Berlin. Accordingly von Helmholtz and some others were invited to be present at the British Association last August, and to sit with the famous B. A. "committee appointed for the purpose of constructing and issuing practical standards for use in electrical measurements." The report of the committee, recently published, says: "During the Edinburg meeting the committee was honored with the presence of Dr. von Helmholtz, M. Guillaume of Paris, Professor Carhart of the United States, Dr. Lindeck and Dr. Kahle of the Berlin Reichsanstalt. These gentlemen came by invitation to consider the question of establishing identical electrical standards in various countries." The committee had two long sessions, and there were present Professor Carey Foster, chairman, Lord Kelvin, Professors Ayrton, Perry and Sylvanus Thompson, Dr. Oliver Lodge, Mr. Glazebrook, secretary, Mr. Preece of the postoffice, Major Cardew of the Board of Trade Bureau and others.

The most important results of these conferences were the abandonment of the time-honored B. A. unit, the disregard of the "legal ohm," and the adoption of the mercury standard of 106.3 centimeters. The reports from Berlin and Paris showed most conclusively that mercurial standards, set up with the precautions recently adopted, agree with surprising accuracy. The uncertainty of the relation between the centimeter and the gramme was avoided by defining the mass of the mercury column of 106.3 centimeters in length, which has a resistance of one ohm. It is 14.4521 grammes. This corresponds to a specific gravity for mercury of 13.5956. "In reality the square-millimeter cross-section remains the elementary definition, but with the specification that this is arrived at by mercurial weighings."

Standards of resistance for industrial purposes in solid metal will still be made as heretofore. But it must be borne in mind that such resistances, especially when made of alloys, should be kept at a temperature near the one at which they have been standardized; otherwise small changes take place in the resistance, due perhaps to a kind of annealing and re-crystallizing process.

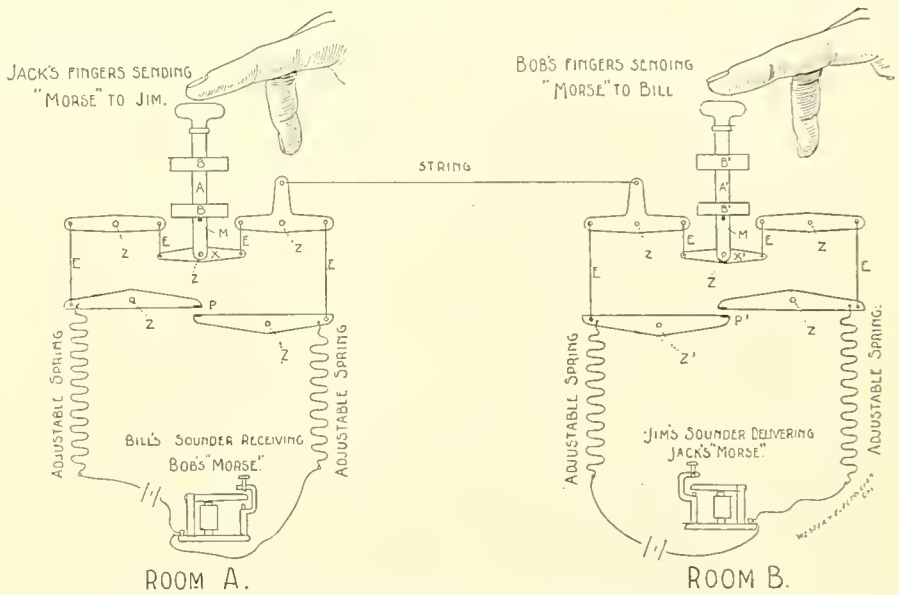
It was further agreed with regard to the unit of current that the number 0.001118 should be adopted as the number of grammes of silver deposited per second from a neutral solution of nitrate of silver by a current of one ampere. This corresponds to 4.025 grammes per hour. The silver voltmeter, with the proper manipulation, becomes, therefore, a secondary standard for the determination of the unit current.

The electromotive force of the Clark standard cell has been re-determined both in Berlin and Cambridge, England, within a year or two; and the results are in rather surprising agreement. A comparison of these determinations led the B. A. committee to decide upon 1.434 as the number of volts representing the electromotive force of the old form of Clark cell at 15° C. containing a saturated solution of zinc sulphate and crystals in excess. This is .001 volt lower than the value heretofore assigned to this cell. It was not determined to adopt this form of cell as the standard, but only to decide upon its voltage when set up by competent persons in accordance with certain specific directions. My own form of Clark cell is perfectly portable, has an electromotive force of 1.44 volts at 15° C., and its change of electromotive force with temperature is only half as great as that of the old Clark cell containing crystals.

We have as yet in this country no bureau where concrete standards of resistance and standard instruments for other electrical units are preserved. Such a bureau, under federal control, is greatly to be desired. Germany has its Reichsanstalt, under the direction of von Helmholtz, in Berlin; England has not only the standards of the British Association in the keeping of Mr. Glazebrook at Cambridge, but also the Board of Trade bureau in London, under the directorship of Major Cardew. Mr. Glazebrook undertakes the comparison and certification of standard coils for the English-speaking world while the bureau in London issues certificates of instruments for commercial purposes in Great Britain.

Government bureaus mean certified standards and

1. From *Science*.



AN INVENTION WITHOUT COMMERCIAL VALUE.

egally adopted units. The decisions of the B. A. committee last August were with the full concurrence of Prof. von Helmholtz, and it is understood that the German government will adopt the B. A. proposals. The committee appointed by the Board of Trade in London has already made its supplementary report in accordance with the conclusions of the B. A. committee, and these units will doubtless very soon acquire a legal character in England. The coming electrical congress in Chicago will afford an opportunity for official delegates to adopt these same units for their respective countries, and official ratification will then naturally follow. Lord Kelvin (Sir William Thomson) predicted at the close of the Edinburg meeting that the system of units adopted by the B. A. committee will become thoroughly international. It should be the duty and pleasnre of all electricians to contribute toward this result.

Electric Bolt Operating Mechanism for Safes.

An interesting application of electricity is presented in the arrangement invented by Emory Stockwell and Herbert C. Stockwell of Stamford, Conn., in which the locking mechanism of safes is operated by a small motor. Heretofore the bolts of safes have been commonly thrown by the nse of weights or springs, but their action is so suddeo as to jar the mechanism of the bolt work and cause tronble unless it is properly cushioned. It has also been proposed to operate the bolt work by means of an electro-magnetic step-by-step mechanism, or to employ such a mechanism as supplementary or auxiliary to a time-lock, so that in case the time movements fail to complete their work, the electrical device gradually runs down the unlocking mechaoism of the time-lock to allow the dog to fall.

The invention illustrated in the accompanying cuts consists of a reversible electric motor connected by a suitable train of gearing to the bolt work of a safe, automatically disengaging the motor from the bolt work, and a time-lock for throwing the motor into engagement again at the proper time. When the motor is revolved in one direction the bolt work will be thrown into locked position and automatically disengaged from the motor. The bolt work remains in locked position, disengaged from the motor, until the operation of the time lock to throw the motor into gear again. Then by revolving the motor in the opposite direction the bolt work is thrown into nnlocked position and the motor again automatically disengaged.

The invention illustrated in the drawings consists of an electric motor supported by suitable brackets on the inside of the safe door and having a sectional armature

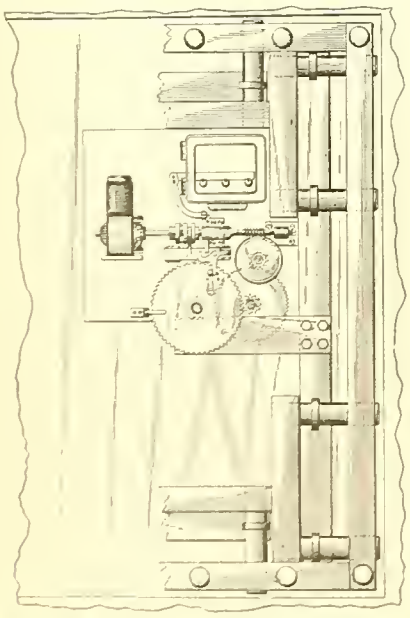


FIG. 1. ELECTRIC BOLT OPERATING MECHANISM FOR SAFES.

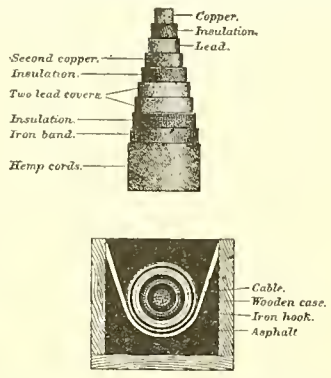
shaft provided with an automatic clutch for placing the two sections of the shaft into engagement. The clutch is held out of engaged position by means of a small spiral spring, and thrown into engaged position by a sliding bolt engaging one member of the clutch. One section of the armature shaft is formed with a worm which engages a worm wheel of a train of gears, the last wheel of which is provided with a small pinion which engages a rack bar connected with the bolt work for throwing it in and out. The sliding clutch actuating bolt is provided with a pivoted spring latch which holds the clutch normally in position, and which is automatically disengaged from its retaining stop by means of a pin on one of the gear wheels to allow the clutch shifting spring to throw the motor out of gear at the completion of the movement of the bolt work into locked or unlocked position. A time-lock actuates a lever of peculiar shape for shifting the clutch bolt and throwing the clutch into engagement, when, by completing the circuit, the motor can be rotated and the bolt work operated.

The battery for supplying the electric current to the motor can be either inside or outside of the safe, and the wires forming connections between the motor battery and circuit closer on the outside are passed through zig-zag passages in the wall or door of the safe so as not to materially weaken it.

As auxiliary to the invention, a burglar-proof housing is employed for inclosing and protecting the circuit closer, which preferably consists of a cylindrical housing attached to the safe door and provided in its front with a rotatable screw door, locked by a combination lock, whereby the motor cannot be actuated for unlocking the safe, even at the predetermined time, unless the operator knows the combination to the chamber in which the circuit closer is situated.

Fig. 1 is a detail inside elevation of a portion of a safe door, representing the improvements applied to the bolt work. Fig. 2 is an enlarged detail edge view of a portion of the door. Fig. 3 is an enlarged detail side elevation of part of the operating mechanism, the motor shaft being shown in section. In the cuts the mechanism is shown in unlocked position in readiness for throwing the bolts in locked position.

It will be observed that the bolt work can be easily thrown into locked and unlocked position by changing the direction of rotation of the motor. It is clear, however, that when the bolt work is fully thrown in either direction the motor should be disconnected, as otherwise its contin-



ELECTRICAL DEVELOPMENT ABROAD.

ued revolution would cause injury to the mechanism. To effect this result means have been devised for automatically disengaging the clutch at the completion of the movement of the bolt work in either direction.

On the gear wheel a pin is placed so that when the bolt work shall be fully locked this pin will impinge against the arm of the latch and shift it, allowing the spiral spring to shift the movable member of the clutch and disengage the motor from the train of gearing. The parts will safely remain in this position and allow the motor to continue its revolution without harm as long as the current remains on.

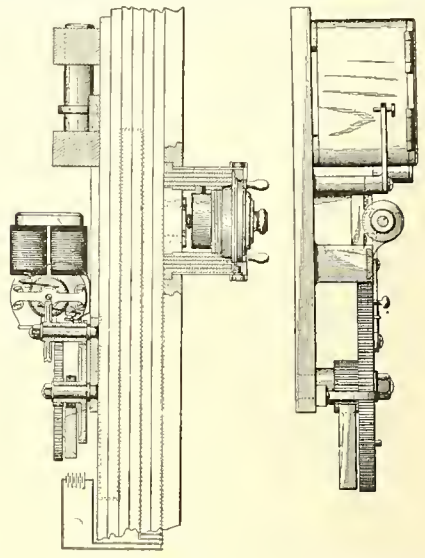
In combination with the mechanism for operating the bolt work a suitable time-lock for re-establishing the connection between the sectional armature shaft at a certain predetermined hour is provided, so that after the bolts have been moved into locked position they cannot be retracted, even by the operation of the motor, until the arrival of the hour set.

Baker Submarine Boat.

According to a Washington correspondent the bureau of ordnance is receiving many inquiries regarding the requirements for the submarine boat which the navy department is able, under the latest appropriation act, to purchase and experiment with. There are only two propositions so far received which are worthy of serious consideration. One is from John P. Holland of Newark, N. J., and the other is from G. C. Baker of Chicago. Mr. Baker's boat, which was described and illustrated in the WESTERN ELECTRICIAN at the time the first trips were made with it, has received much consideration. The bureau of ordnance proposes, if this boat shall prove satisfactory, to apply a dirigible torpedo, and the experts believe that this application would be entirely practicable with either the Sims-Edison or Patrick methods of propulsion in a torpedo. Mr. Baker believes that his boat can be built for $75,000, which is within the $150,000 Commodore Sampson is willing to spend of the $200,000 appropriated by Congress. The remainder of the amount will go for experimenting with the accepted boat. Mr. Holland's boat is of an entirely different type from Mr. Baker's, and, as he says, "is not intended to compete with a diving submarine boat, which possesses certain advantageous features that no other form of boat can attain, but it represents more nearly how much a Vesuvius could be improved for less money than she cost."

Electrical Development Abroad.

Last year all United States consuls were directed by the state department to prepare reports on the use of electricity for the propulsion of farm machinery and in the propagation of plants in their respective districts. These reports



FIGS. 2 AND 3. ELECTRIC BOLT OPERATING MECHANISM FOR SAFES.

are now all in and have been issued for the information of the public. Most of the consuls did not confine themselves to electricity in agriculture alone, but briefly summarized the results in the entire field of electrical development in the districts in their charge. Many interesting facts are contained in these reports, extracts from a few of which are given below.

Consul Rublee of Prague reports that there is little demand in Bohemia for labor-saving inventions and that "the introduction of such an innovation as electricity will be very slow." This is also the tenor of several other reports from districts in continental Europe, where labor is very cheap and the landed proprietors feel the obligation of keeping the dependent peasants supplied with work.

From Belgium it is reported that a threshing machine requiring 12 horse power has been operated by electrically transmitted power from a distance of 800 meters. This permitted the utilization of a stationary mill engine.

At St. Briene, France, the electric lighting installation is located 12 kilometers from the city and is operated by water power. It supplies 1,200 incandescent lamps very satisfactorily.

Consul Williams of Rouen, France, says: "Attempts have been made to pass electric currents in buckets where seeds were washed preparatory to sowing, in order to destroy microbes invisible to the naked eye. It has been claimed that the germinating power of the seeds was thus increased, but the experiments were considered rather more curious than practically useful." He also makes this curious statement: "As a motor, electricity is only practicable in proximity to large waterfalls. The separation of the fluid in transmission renders it more uncertain and expensive than steam power."

In St. Etienne, France, steps are about to be taken to operate the looms by electricity, but the application of electricity in agriculture has not been thought of.

The most elaborate report is made by Albert H. Washburn, commercial agent at Magdeburg, Germany, who begins by saying: "The influence of atmospheric electricity in the propagation of plant life has long since been recognized. Attempts, however, to solve the problem of the exact relations existing between this natural force and the growth of plants have been numerous, it is true, but invariably futile. The ill success attending these efforts naturally turned the attention of scientific agriculturists to another quarter—to the possibility of experimenting with batteries. Much that has been written upon this subject is confusing to the general reader. Widely differing results have been published, and it has followed that neither the favorable nor the unfavorable influence can be said to have been clearly established. So far as the German experiments go, the substance of most of them show results decidedly adverse to electricity—at least to its employment as a practical factor." The results of several series of

experiments by German professors, with many tables, are given, and Mr. Washburn draws the following conclusion: "The question of the propitious or unpropitious influence of the induction or galvanic stream upon plant life has found in this country, up to the present moment, no real practical solution; nor is one believed to be easily possible. While it is true that some few isolated experiments have been highly favorable to electricity, those conducted on the most extensive scale have resulted in very indifferent success. For the rest it is evident that the obstacles in the way of locating with any exactness the point where the favorable influence stops and the unfavorable begins are too great, and a practical regulation of the current is scarcely to be hoped for."

Consul Warner of Cologne, Germany, devotes himself to a description of the municipal electric lighting plant. Zipernowsky alternators, operating at the rate 6,000 alternations per minute, generate current at 2,000 volts, which is transformed down to 72 volts for the secondary circuits. The following extract is worth reproducing:

An interesting feature is that the two boilers in service also supply steam to the pumping machinery of the waterworks, to which they are connected by a common system of steam pipes. This is an economical way of producing the necessary steam, and it is made possible by the fact that during the summer little light is used during the day, but very much water must be supplied, while during the night the consumption of water is small and that of light is large. In winter, of course, there are either more boilers at work or each station produces the necessary steam for its own electric or pumping machines.

The capacity of the network of wires is 20,000 burning lamps of 16 candle power each. The cables used are iron-bound, lead covered, concentric cables of various diameters and cross sections (See cut, p. 180.) The concentric arrangement was chosen in order to avoid any disturbances which might come from the alternating current to the telephone net-work, for which earth is used for the return circuit. The imperial postoffice is preparing to put down underground telephone cables, as their trials have shown that no disturbance arises from the neighborhood of the concentric cables of the electric central station. The total length of the cables is 20,000 meters. From the central station there are three feeders, each of a sectional area of 220 square millimeters for each conductor, which are connected with five mains, with a cross section of 185 square millimeters for each conductor. The mains are connected with and joined by distributing leads forming a network. By means of stations parts of the cable which need repair or where the connection for a new consumer must be made may be disconnected from the rest so that the work may be performed without any risk to the lives of the workmen. The disconnecting stations have been placed in several public buildings or in small barracks near them, and can, of course, be opened only by the officials. The cables are run through the streets below the side-walks at a depth of 0.75 meter. They are placed in wooden boxes at lengths of 3 to 4 meters. The heavy cable is held in position by iron hooks, and the whole of the wooden box is filled with molten asphalt. In order to avoid any mechanical damage, the whole mass in the box and the box itself are covered with layers of bricks under the street pavements. The connections from the cable to a house are made by T-shaped joints, and the transformers and meters are placed in the cellars of the houses.

The consul at Frankfort reports that there is a project under consideration to erect a plant at a waterfall in the vicinity of Lake Constance to generate electricity on a large scale by water power and distribute it to the neighboring farms to be used for threshing, pumping, sawing wood, and other forms of agricultural labor. But this scheme is as yet only incipient, and it will be a long time before it can come to any practical result.

From Glasgow Levi W. Brown sends this surprising report, dated June 30, 1892: "The use of electricity in agriculture is unheard of in this part of Scotland. Every person to whom I have addressed the inquiry appeared astonished at the suggestion of a possibility of such a thing. The fact is, electricity is but little used in this consular district. In this great city, the home of Lord Kelvin (Sir William Thomson), perhaps the most famous electrician in the world, has hardly commenced the use of electricity. Perhaps a half dozen public buildings and an equal number of stores and private houses (the house of Sir William Thomson included in the latter) are lighted with electricity, but I am not aware of its being used as a motive power in a single instance. There is some talk looking to its use as a motive power for street car service, but I believe no definite plans are as yet formulated."

Electricity is not used in Spain as a power for the propulsion of farm machinery or implements. "Ninety per cent. of the farmers of this province don't know what electricity is, and not one has ever thought of using it as a force for the propagation and growth of plants," was the answer given to Consul Turner of Cadiz by the officer in charge of the agricultural interests of the province.

Thomas Adamson, consul-general at Panama, thinks that it is not probable that electricity will ever be needed to assist the growth of plants on the isthmus, as they grow so rapidly as to stifle agricultural efforts.

After saying that electricity is not used in Cuban agriculture, Consul Cheney of Matanzas continues: "The sugar planters of Cuba are probably as keen to scent a possible honest dollar of profit as men in general. They have brought the culture of cane and its conversion into sugar to a high degree of perfection; but it would seem to devolve upon the electrician to convince them that the subtle agent which is rapidly revolutionizing a world can be profitably applied in the culture. I have no doubt that they would respond quickly to such a showing."

In Dutch Guiana the application of electricity for the drying of cocoa has been tried, but so far without success.

From Ceylon this suggestion is sent by Consul Morey of Colombo: "The tea enterprise, especially in the central province, or mountain zone, could probably be much helped by the introduction of electricity as a motive power for the machinery universally in use for curing tea. Steam is now used for that purpose, and, as fuel is becoming scarce and dear, it would appear as though there was a good opening for the more novel power, which could probably be used most economically on account of the numerous perennial streams abounding in that locality, from whence the inceptive power for utilizing electricity is easily obtainable. It might be worth the while of some of the electric power people in the United States to exploit this promising locality."

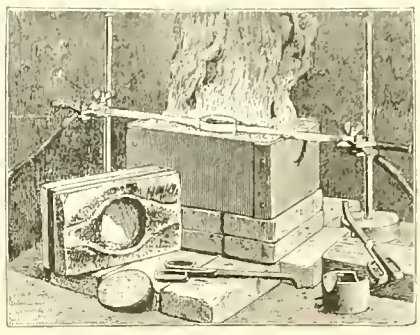


FIG. 2. MOISSAN DIAMOND MAKING EXPERIMENTS.

The consul at Malta reports, under date of January 13, 1893, that the electric light will probably be introduced in that place. W. H. Preece of London has recommended that the government establish and maintain the plant. Mr. Preece does not doubt but that all the conditions can be met, and that an installation could be in working order in Malta by next winter. Should American companies desire to submit tenders for the electric light in Malta, they can obtain all the necessary specifications and plans for what is required by addressing W. H. Preece, chief engineer of the London postoffice, England, or the chief secretary to the government, Malta. "It would be a splendid advertisement," says Consul Worthington, "for any American firm to secure the contract for lighting by electricity the renowned, historic and much-visited island of Malta. I would do more than a little to assist in the accomplishment of such an enterprise."

American Bell Telephone Company.

The annual meeting of the American Bell Telephone company was held at Boston on March 28th. The net earnings were $3,411,671 against $3,126,519 the previous year, and $2,869,418 in 1890.

The following items are taken from the annual report: Number of instruments under rental, 552,720; increase, 40,313; exchanges, 812; increase, 24; total miles of wire, 307,791; increase, 41,335; number of circuits, 201,322; increase, 14,860; employes, 9,970; increase, 1,594; number of stations, 232,149; increase, 16,123; number of daily connections in the United States, 1,868,189; increase, 283,477. New York has 28,216 miles of underground wire; increase, 1,335; Chicago, 14,010; increase, 6,722; Boston, 8,281; increase, 601. The long-distance system netted last year $274,449, which was invested in plant.

About 150 stockholders attended the meeting. The directors and officers were re-elected, and it was voted to increase the capital stock from $17,500,000 to $20,000,000, stock to issue at par to present holders in the proportion of one new share for seven now held.

Moissan Diamond Making Experiments.

Henri Moissan's experiments with the electric furnace described in the WESTERN ELECTRICIAN, March 25th have created a positive sensation in Parisian scientific circles. The enthusiasm seems to be shared by attendants at the schools. Moissan was recently invited to address the students of the College of Pharmacy. When he entered the lecture hall the 1,000 young men who had gathered gave the scientist a reception which fairly overwhelmed him. The cheering continued for a space of five minutes, according to reports in the French papers.

At the session of the Academy of Sciences in Paris March 6th Moissan gave additional details of his experiments of making diamonds by artificial means. He spoke especially of the fact that traces of iron are always found when a diamond is burned. He demonstrated this statement by experiment, but the proof is not an easy matter to secure for the reason that he deals with such minute quantities of matter. In his lecture the weight of diamonds consumed was only a few milligrammes. It was noted at the time that at the present day there is no Grand Duke of Florence to put his jewel box at the disposal of an academician. At the meeting of the Academy on March 13th Moissan exhibited a number of specimens of metals ordinarily regarded as refractory which he had reduced in his electric furnace.

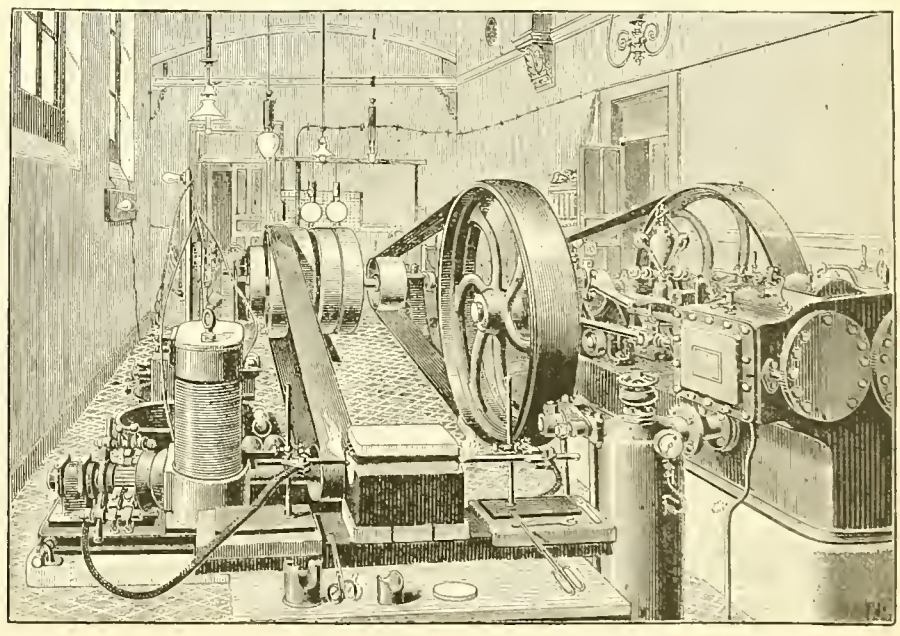


FIG. 1. MOISSAN DIAMOND MAKING EXPERIMENTS.

The French government has taken an interest in the experiments and has authorized Moissan to continue his investigations at the Conservatoire des Arts et Metiers. He has been furnished there adequate facilities and has interested in his investigations Prof. Violle of that institution. The government believes that the experiments have an important bearing on metallurgy and that they should therefore be encouraged.

The accompanying illustrations, Fig 1, showing the electric plant from which current for the furnace is derived, and Fig. 2, showing the furnace just after it has been in use, are reproduced from *La Nature*.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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ILLINOIS is not the only state that has a Legislature which has developed a fondness for unconstitutional measures. In New York a bill is under consideration which provides for regulating the charges of telegraph messages "for all distances," that is, the New York Legislature assumes to dictate to telegraph companies the prices to be charged for communication between points in that state and other states. Of course the state Legislature has no such power. The Supreme Court of the United States has decided that such power rests in Congress alone. It has declared that it is not only the right but the duty of Congress to see that the transmission of intelligence between the states shall not be obstructed or unnecessarily encumbered by state legislation, and that communication by telegraph between different states is free from the control of state regulations. This position is based upon the fact that telegraph companies are common carriers of messages and that their business between points in different states is inter-state commerce. Another feature of the case is the fact that the Western Union Telegraph company, which controls most of the lines in New York state, has accepted certain privileges from Congress, and assumed certain responsibilities and obligations, which places it directly under the control of the national government to the exclusion of state interference. If the Legislature of the state of New York has any power to regulate telegraph rates, its authority is restricted to the business conducted between points in that state. Outside of its territorial limits it has no jurisdiction.

ASIDE from the incandescent lamp litigation, there has been no legal decision recorded in recent years that has been received with so much attention by the electrical fraternity as that handed down by Judge Greene, of the United States Circuit Court, at Trenton, N. J., on March 28th, in which the Edison "feeder and main" patent is sustained. This decision affects not only central station lighting companies, but also nearly every overhead trolley system of street railways in the country. The patent covers broadly the system of distribution employed on trolley lines and in its wide application may be classed with the Brush arc lamp and Edison incandescent lamp patents. The value of the invention was not fully appreciated when the patent was issued; in fact, the question as to whether it was an invention or merely an application of an old engineering principle was raised in the litigation. The decision of Judge Greene is not, of course, final, and there is no doubt but that the case will be bitterly contested in the higher court before final decision is reached. It is, nevertheless, a material victory for the Edison interests, and one that will be persistently followed.

So many facts in relation to the general electrical development of foreign countries are included in the consular reports summarized on another page, which were elicited by a Senate resolution calling for information on the subject of the foreign use of electricity in agriculture, that American electrical manufacturers will do well to carefully consider the possible demand for their goods in the various countries in which electricity has as yet made little headway, but in which an interest in the subject is now reported. The proposed lighting installation in Malta, in relation to which Mr. Preece, the chief electrician of the British postoffice, has made an elaborate report, is an instance of this. The consul at that point thinks that there is an opening for American electrical machinery, and the possibility is at least worth investigation. So in the widely separated islands of Ceylon and Cuba, also, it is reported that electrical lighting and power transmission plants might profitably be installed. In the former country the conditions are particularly favorable to power distribution by electricity, as fuel is dear and water power abundant. To Cuba considerable electrical machinery of American manufacture has already been sent, principally for use in and near Havana, but the consul whose report is summarized in the article referred to is evidently of opinion that the trade could be materially extended if the matter was put before the sugar planters of the interior in the proper light. These suggestions may prove of value and should not be neglected.

Several curious facts are brought to light in these reports, such, for instance, as the surprising backwardness in electrical development of such a city as Glasgow, the second in Great Britain in point of population. It is also shown that in many European countries labor is so cheap that it does not pay to employ electrical or any other labor-saving devices in agriculture.

MUNICIPAL lighting projects seem to have the same disadvantages the world over. In Zurich it appears that the people have been waiting since 1887 for electric lighting, and that although much attention has been given the subject the city is now only partially supplied. Prior to 1887 many applications had been made by private enterprises for permission to engage in the business of commercial lighting, but the sentiment for municipal control of such projects was so strong that it was impossible to obtain a franchise. When the question was taken up in 1887, the city engineers were instructed to furnish plans for an electric lighting plant. Two years later their report was presented. Another year followed before propositions were called for and not until last December was there any visible evidence of the fact that the city had undertaken the project. At that time the present plant was started, but it is only a small part of what will be required to properly illuminate the city, and in reality only about one-half the size of the plant provided for in the original plans of the city engineer. It will be readily seen that it will be some time before the city of Zurich will have anything like a comprehensive system of electric lighting. But Zurich is not the only city in which private enterprise has been discouraged in order to establish public departments that would add to the patronage at the disposal of political bosses. In this country there are similar cases, though there has not been such flagrant mismanagement as that reported from Switzerland. It is a fact though that Chicago's much boasted city lighting system has been extended very little since its establishment and that there are to-day four large stations in this city only partly equipped. Not one of the city plants is running at full capacity, and it seems impossible to get appropriations for extending the system and taking advantage of the costly plants that the city has constructed. Yet when private concerns apply to the city council for franchises, there is a general cry against granting any further privileges, owing to the fact that "the city is going to extend its system." But when is this extension to take place and how is the the money to be raised? City electrician Barrett has been unable to get appropriations from the general fund for this purpose sufficiently large to undertake any extensive work, and his efforts to secure the passage of ordinances providing for new circuits to be built under special assessment have thus far been fruitless. In the meantime, citizens are deprived of the advantages of electric lights for their shops and residences. Even should the city decide to engage in the work of extending the present system, it would be out of the question to think of supplying commercial lights. Prof. Barrett realizes this, and his objections would no doubt have great weight with the council and the state legislature. It will unquestionably be many years before the streets of Chicago are thoroughly lighted, and until this is accomplished there can be no excuse for the city engaging in commercial lighting.

DISCUSSION of the bill now pending in the New York Legislature providing for the establishing of a telephone commission reveals the fact that, whatever may be the desire of the people throughout the state, the prevailing sentiment at Albany is against such a measure. While the merchants and manufacturers of New York, Brooklyn and other cities of the state are holding meetings and framing petitions calling upon the Legislature to grant them relief from what they term the oppressive rates imposed by the telephone companies, the McMahon bill is kept in the Senate committee, and at the present time there appears to be no hope for its adoption. A year ago a similar bill was before the Legislature and at that time the measure received the earnest support of some of the ablest men in that body. But a wondrous change has come over the Senate—the men who advocated the bill a year ago are now as earnestly working to defeat it. Senators Plunkett and Cantor, who fathered and championed last year's act, are now leading the opposition forces. They do not believe a commission necessary, they say, and the question of regulating telephone charges should be left to the different city councils. It is provided in the McMahon bill that this power be vested in a state commission. There are many prominent men throughout the state who do not favor the establishment of a new commission, although they are earnestly in favor of extending the jurisdiction of some existing board or commission so that it shall have power to settle telephone disputes. They think that these duties might easily be performed by the state railroad commission, for instance. That body has very little to do and could easily attend to telephone controversies in addition to its present duties without imposing additional expense upon the state. It is generally conceded that states have the right to regulate the charges for local telephone service, and the advocates of this proposed measure cite in support of their claims the decisions in the courts of last resort in Indiana, Nebraska, Missouri and Ohio, where test cases have been tried. In some states the Legislatures have authorized certain city councils to fix rates, as in St. Louis, for instance. The Supreme Court of Missouri declared that this delegation of authority was valid. There is no question but that this authority is liable to be greatly abused. Many rural legislators entertain a deep resentment against all corporations, and they are often actuated by a desire to get even, on general principles, with any that may be so unfortunate as to come within the scope of their power. Sometimes the oppression is too great even for hardened corporations to stand, and they retaliate. It will be remembered that in Indiana the telephone company, after being overwhelmed with adverse Legislation, closed its exchanges and quit business. This brought the legislature to a realizing sense of the position it had assumed, and it revoked the obnoxious measures at the general demand of the public, and the telephone companies resumed operations.

It is bad policy to encourage state Legislatures or municipal councils to interfere in the management of private or quasi-public enterprises. The remedy is generally to be found in a conservative middle policy—the company furnishing first-class service at reasonable rates and the public showing some consideration and forbearance when everything is not just as it should be.

Edison Feeder Patent Sustained.

On March 28th Judge Greene of the United States Circuit Court at Trenton, N. J., handed down a decision in the case of the Edison Electric Light company against Westinghouse, Church, Kerr & Co. in which the feeder and main patent, number 264,642, granted to Edison on September 19, 1882, was sustained. The action was begun in 1886 and the final hearing was had before Judge Greene in May last. The patent in question covers "a method of equalizing the tension or pressure of a current through an entire system of electric lighting or rather translation of electric force, preventing what is ordinarily known as a drop in those portions of the system the more remote from the central station."

In his specifications Mr. Edison describes the methods employed for obviating this trouble. Feeding conductors are provided in this system "which extend from the generator or generators to the main conductors of the lamp or consumption circuit or circuits, such feeding conductors not having any translating devices connected therewith, and being connected with the main conductors of the consumption circuit or circuits at the center, ends or other points on such main conductors."

Following are the claims of the patent.

1. A consumption-circuit in the main conductors of which the drop in tension is not sufficient to vary practically the candle power of the lamps connected therewith, in combination with feeding conductors connecting the consumption circuit with the source of electrical energy, and having no translating devices connected therewith, the drop in tension upon such feeding conductors not affecting the relative candle power of the lamps of the consumption-circuit.

2. A consumption-circuit in the main conductors of which there is a definite small drop in tension not sufficient to vary practically the candle power of the lamps connected therewith, in combination with feeding conductors connecting the consumption circuit with the source of electrical energy, and having no translating devices connected therewith, the loss upon such feeding conductors being greater than upon the main conductors of the consumption-circuit.

3. The combination of a consumption-circuit, in the main conductors of which the drop in tension is not sufficient to vary practically the candle power of the lamps connected herewith, with a feeding-circuit having no translating devices, and extending from the source of electrical energy to the center of the consumption-circuit.

4. The combination of two or more central stations having feeding conductors, and consumption-circuits supplied by such feeding conductors, as described, of connections between the conductors of the central stations.

5. The combination, in one system, of a main circuit connected directly to a source of energy containing translating devices, and provided with resistances for lessening the tension or pressure of the current to that of the average of the system, a circuit not directly connected to the source of energy containing translating devices, and a feeding circuit connecting the latter circuit with the source of energy.

6. The combination of a number of uninsulated wires of different lengths grouped together and fastened at intervals, forming a gradually tapering conductor.

It will be seen that this patent broadly covers the feeder system generally employed in electric street railway systems throughout the country. In the case just decided the defendants claimed that the subject of the patent was not an invention but merely application to electrical engineering problems of well known principles employed in the distribution of gas and water. The complainant, however, contended that there was an essential difference between the two systems and pointed out that one required only an out-flow system while the other required a return system as well. Other points of resemblance were pointed out by the defendants, but in reply to these the complainant contended that there was a radical difference between gas and water on one hand and electricity on the other; that the laws governing the so-called flow of electricity were different from those governing the flow of gas and water; that the surrounding and interfering conditions were dissimilar; that the conditions of economy were unlike, and that the incandescent lamp bore no analogy to any device employed in gas and water systems. The rough analogies between the two systems, it was claimed, were not sufficient to teach the electrical engineer that the idea of the so-called "independent main" could be adapted to a system of electrical distribution. The decision sustaining the Edison patent virtually gives the General Electric company a monopoly of street railway systems employing feeders. It is expected, however, that an appeal will be taken from Judge Greene's decision.

The Point Defiance Street Railway company of Tacoma, Wash., is building a fifty-six foot boat to be operated by storage batteries. It will be put on the Gig Harbor and Floating Dry Dock route, in connection with its street car lines. The boat will be equipped with seventy-five cells for twelve hours' service. The battery will be charged at night from trolley wires. The vessel will have a breadth of beam of 10 feet and depth of 4 feet, and will be built for a regular speed of fifteen miles per hour.

Chicago Electric Club.

Following the reading of the paper by Messrs. Pumpelly and Sorley before the Chicago Electric club, March 20th, on the "Present Status of the Storage Battery," there was an interesting discussion, of which the following is a stenographic report:

J. W. JOHNSON: What is the ampere hour capacity of that battery at the normal rate?

C. SORLEY: At the normal rate it is 177.7 ampere hours by actual test.

J. K. PUMPELLY: We generally test a battery to what you might call ten per cent. of the claimed capacity in the discharge of current. A battery should be discharged, if possible, in ten hours in testing. Twenty-three amperes is more than ten per cent. of even what we get out of it; so that at its ten per cent. discharge it would probably give us about 200 ampere hours. One-half the weight of such a battery would run a light carriage from five to six hours, carrying two people.

F. E. DEGENHARDT: During the last two years Mr. Keller and myself have conducted experiments with the view of perfecting a vehicle for carrying passengers about the city. Our experiments led us in a slightly different direction from that ordinarily followed in traction work as applied to street cars. This latter service calls for unusual conditions, the loads are varying and the tax on the battery at times is very great In the propulsion of carriages by electricity the demands are also great, for while the loads do not vary the demand on the battery is at times very great. The demand is for a battery of large capacity that will occupy comparatively little space.

While it was our aim in our experimental work to confine the voltage to as low a point as possible, that is, about twelve volts, we found it necessary to use a battery which would come to the rescue when we were climbing grades like those at the bridges. The pasted batteries, that is, the batteries in which the plates have received the oxides by pasting, were found to be very weak as a rule. We discovered early in our work that there was a shortness of the fibers. Where the paste was applied it was evident that the molecules were finely broken up in pasting; while there was an adhesiveness in the method of pasting, still the molecules were so fine that when subjected to rough usage, such as going over cobble stones and uneven surfaces, the paste was gradually loosened by jarring. Consequently we were introducing an element not fitted for that kind of work. Later on in our experimental work we were brought in contact with a battery made electrolytically. An examination of the plates of this battery disclosed the fact that there was a flocculent condition of the lead, which the pasted battery did not possess. A close observation of this led me to the conclusion that it was due to the fibres of the lead interlacing, as it were, instead of being broken up into small particles, as in the paste. This flocculent condition was brought about by an interlacing of the particles as the oxide was formed, consequently giving a tenacity which the paste itself did not possess. It was our pleasure to find that there was practically no falling off of the oxide; at least we did not find any to speak of at the bottom of the cell, nothing that would injure the life of the cell. Another very important fact established by these experiments was that there was no buckling of the plates. A very necessary quality in such a cell is ability to retain its voltage. A reading taken from a large number of pasted cells showed us that the voltage at first fell away very slightly, a trifle less than the voltage of this type of cells of which I now speak. However, as we progressed with our work the line of reading fell away gradually, and finally it dropped right off. The readings taken from the cell which was manufactured, as I think, much on the same line as that followed by Messrs. Pumpelly and Sorley, extended almost in a direct line until the final moment, when the cell collapsed altogether. It is a very desirable thing in all traction work, to maintain a high voltage, for without high pressure it is absolutely impossible, in my judgment, to climb grades and get the efficiency from the battery to do the work of moving vehicles. A curious feature enters into the propulsion of vehicles, which is not unlike the severe test that a car subjects the battery to. In the case of a car you move along on a plane surface, but you stop frequently, and there are varying loads on the car. Sometimes you may carry fifty passengers and then again you will only carry ten; and it is the logical conclusion that in overcoming the inertia of a mass representing fifty passengers you call for more energy than you do in overcoming the inertia represented by ten passengers. However, in the case of a vehicle for street use, we discovered that the road over which we traveled had much to do with taxing the energy of the battery. Without a rubber-tired vehicle we learned that an ordinary dirt road or a macadamized road was the most desirable. When we got on the asphalt pavement we naturally supposed that we had a perfect condition. We were mistaken. A series of experiments demonstrated to us in a very short time that it required no less than 21 per cent. additional energy to move the vehicle over the asphalt pavement. That seems almost preposterous at first glance; but when you recall the fact that the pavement is of a spongy character, and that the four wheels indent them elves into the asphaltum, you find that you are continually climbing a grade, imperceptible, perhaps, to the eye, but nevertheless you are climbing a grade with four wheels all the time. Wood pavements have objections, because they present varying conditions of surface. The same thing applies to the Belgium block pavement. When you introduce the rubber tire, of course a great percentage of that is reduced. You move along freely over the asphaltum road. And therein, again, comes the desirability of having a battery which will maintain its high voltage until the battery is really unfit for service, and, moreover, the desirability of having a battery which will retain its oxide in position. It must hold itself up; there must be no breaking down of the structural portion of the battery, and the oxide must not fall to the bottom. It is apparent that you must have your battery so constructed that if you propose to run your vehicle for five hours at its maximum capacity of speed, you must have some place where you can renew the battery quickly. Here, it is quite probable, it will be subjected to rough usage. The station man will pull it out of the wagon, drop it on the ground and put in the other cell, connect it up and you start off, over the rubble pavement perhaps You can see that you will need a battery which will hold up, which is strong and won't buckle and won't drop its oxide to the bottom of the cell. Our experience through two years has brought us to the conclusion and the firm conviction that this type of battery, this form preferably of rolled lead, is the best for the propulsion of vehicles; and I do not think I am claiming too much when I say that if this cell holds up to the tests shown us here to night we have the ideal battery in that type. I imagine that the difference between the use of cast lead and rolled lead comes in again much in the way that I have explained—the use of the oxides. There is a broken-up condition in a cast lead through which the molecules by melting have become separated to a certain extent; but in the rolled lead there is a sort of interlacing of the molecules. I would like to ask Mr. Pumpelly if the voltage keeps up approximately near 1 95 during the time of the discharge at the rate given here?

MR. SORLEY: It is kept up very near it with a much higher rate of discharge. The rate mentioned of 80 ampere current at the last reading was 91½; the voltage is dropped to 1 86. That is .08 or .09 less than I stated, but the larger discharge will more than make up the horse power.

MR. DEGENHARDT: I would say that during the last two years several batteries were tried, and it has never been my pleasure to see this cell before. It is true that the cells we used on our vehicle exhibited much the same characteristics; that is, the voltage held up well. We had a good opportunity to judge whether we needed any extra pressure as a reserve, and we came to the conclusion that we did, as it is the pressure that maintains the speed after you have got under way.

MR PUMPELLY: The use of this absorbent protected diaphragm between the plates allows us, in comparison with the battery we are using, to decompose more of the lead plate than would be safe to do if there were no support. We could peroxidize this plate and about two-thirds of all its weight of lead would be active; but with the old batteries we would have to reserve one half of the weight of lead for the active material which has been formed. There is a gain which I have counted on very strongly, and therefore we could give you for a light carriage a light battery.

F. L. PERRY: I would like Mr. Pumpelly to give us an account of the severest test to which he has ever put the new cell—what he considers the severest test of that battery.

MR PUMPELLY: It is hardly fair to say that we have attempted to test the battery beyond what was absolutely necessary for the work that it did. We can discharge it for to or three minutes at from 100 to 150 amperes; but that does not count. It does not hurt the battery. All I can say is that it does not affect it at all. What we were trying to get at, and what our experience has taught us, was to get such an output as would be calculated upon for doing a certain amount of heavy work, and doing it all the time. I have not gone any farther than that, and never thought of going any farther than that. You can fully discharge this battery at once without hurting the plates.

MR. DEGENHARDT: I would like to encroach on your time once more. I recall a test run from Clinton street to Robey street on West Jackson street that took 28 minutes. In starting up we required as high as 30 amperes We were carrying about 1,250 pounds dead weight. When we got under way on the dirt road east of Halsted street we used 27 amperes at 12 volts. When we struck the asphaltum we used 32.4 amperes, and required that amount of current at 12 volts to move us along that road at four and a half miles an hour. We had plain iron tired wheels.

MR. PUMPELLY: You were not satisfied with the work of the motor?

MR. DEGENHARDT: Oh, no; the motor was deficient, but we made the reading under those conditions.

MR. JOHNSON: I remember a battery that was brought out in the early days with a capacity of 150 ampere hours. The case that it was put in was made of rubber, and weighed about 55 pounds. The maximum rate of discharge was 12 to 15 amperes, and they thought it was burning the battery.

A. L IDE: I have been watching the results of storage batteries with a great deal of interest for the propelling of electric launches. I have thought that whenever we could get a battery that would give us as much power and not exceed the weight of a steam engine and boiler, which would give us the power from five to six hours, it would be a great improvement over the present arrangement, especially for a pleasure boat on a body of water like Lake Geneva. There could be twenty five electric launches sold there next summer if a practical battery were produced that was not too heavy, and that would run for five or six hours. Such a launch would be safe and always ready, and any one could run it. An experienced engineer would not be needed. There would be no dust or noise. The batteries could be placed in the bottom of the boat and act as ballast.

G. K. CUMMINGS. Supposing you took one of these rolled lead plates that weigh so much and made it all into oxide. What would be the difference in weight?

MR. PUMPELLY: There wouldn't be much difference in weight for the same size, but you get more amperes out of the same weight; you do not make it lighter, but you get more capacity out of it.

MR. CUMMINGS: That is, a plate of the same weight would give more capacity, would have more active material?

MR. PUMPELLY: Exactly.

ALEX. KEMPT: I believe I sold the first storage battery in the western country up here in Menominee, Mich., and Marinette, Wis. I sold $45,000 worth of storage batteries, the first sale of electrical apparatus I ever made in my life. I need not tell the gentlemen present the result of that sale. While to me it was very satisfactory, as I got 10 per cent. on the sale, for the others it was a very unfortunate transaction. In listening to this paper to night, and to the explanation, which was very plain and explicit, I have been impressed that Mr. Pumpelly and his associate, Mr. Sorley, are to be congratulated on the result of their efforts.

Book Table.

DE MAGNETE. By William Gilbert. Translated by P. Fleury Mottelay. New York: John Wiley & Sons. Price, $4 00.

This book had the advantage of being introduced through what might be called an international controversy. The cause of the dispute was the fact that an English organization known as the Gilbert society and including among its members Prof. Silvanus P. Thomson had been devoting several years to the translation of Gilbert's writings, and the appearance of this book greatly reduced the value of its work. Of course Prof. Thomson and his admirers were very much chagrined to find that they had allowed their work to be anticipated by an American publisher, but they consoled themselves with the reflection that none but theirs would be worthy of serious consideration. It was intimated, too, that Mr. Mottelay's translation had been hurried in order to anticipate the English society's work, and that the value of the book would suffer by reason of the insufficiency of the time devoted to the task. Any fears that may have been entertained on that score may be dismissed. The work has been carefully done, and it bears evidence of thorough and intelligent research. Mr. Mottelay is certainly to be congratulated.

Of the work itself little may be said. Gilbert's "De Magnete" made a great impression throughout the scientific world when it was first published, and those who read it to-day in the light of the great advancement that has been made are equally impressed by the striking originality and prescience displayed throughout the work. The biographical memoir which accompanies the book is an interesting contribution On the whole, this volume is a most creditable production.

ALTERNATING CURRENTS: AN ANALYTICAL AND GRAPHICAL TREATMENT FOR STUDENTS AND ENGINEERS. By Dr. Frederick Bedell and Dr. Albert G. Crehore. New York: W. J. Johnston company, Limited. 325 pages, 112 illustrations. Price, $2.50.

This book is practically a reproduction and elaboration of several valuable papers by Messrs. Bedell and Crehore in American and English technical journals. The subject is treated in two distinct parts, analytical and graphical. Part one contains the papers on the analytical development of the subject commencing with circuits containing resistance and self-induction only, resistance and capacity only, and proceeding to more complex circuits containing resistance, self induction and capacity, and resistance and distributed capacity. The remaining chapters are devoted to the graphical consideration of the same subjects.

THE ELEMENTS OF PHYSICS. By Henry S. Carhart, M. A., and Horatio N. Chute, M. S. Boston: Allyn & Bacon.

As the title of this work implies, the book is intended principally for use in the class room, and, with the names of two such experienced instructors as its authors, it will be generally accepted as covering the essential features which are needed in teaching physics. Is has been the aim of the authors to formulate clear statements of laws and principles and to illustrate them by simple experiments and problems. In this they have succeeded admirably, and the result of their labors, embracing as it does the experience of many years in the class room, will be welcomed by their fellow instructors.

THE MEASUREMENT OF ELECTRICAL CURRENTS AND OTHER ADVANCED PRIMERS OF ELECTRICITY. By Edwin J. Houston, A. M. New York: W. J. Johnston company, Limited. 429 pages, 169 illustrations. Price, $1 00.

This second volume of Prof. Houston's series of elementary electrical treatises for students and non-technical readers derives its title from the first three primers, which are on the measurements of electric currents, electromotive force and resistance, respectively. The object of these primers is not so much to teach the practical operations of electrical measurements as to explain the principles and apparatus upon which they are based.

Two primers are on voltaic and thermo-electric cells and other sources of electricity. The principles upon which commercial currents are based are considered in three primers, and nine others are devoted to the principles and applications of dynamos, motors and transformers, the eighteenth and last primer being a review or primer of primers.

THE VOLTAIC CELL. By Park Benjamin, L. L. B., Ph. D.; 562 pages. New York: John Wiley & Sons. Price, $5.

The object of this work is to assist the student and the investigator by placing before them the record of the principal discoveries and researches relating to chemical generators of electricity, descriptions of many of the most distinctive and approved types of cells, and the latest information as to their efficiency measurement and modes of use. The arrangement of the work is excellent, and a carefully prepared index adds greatly to its value as a book of reference.

ELECTRIC RAILWAY IN THEORY AND PRACTICE. By O. T. Crosby and Dr. Louis Bell. Second edition. New York. W. J. Johnson company, Limited. 416 pages 182 illustrations. Price, $2 50.

This new edition has been somewhat changed and several additions have been made to the original work. Two appendices have been added treating of "Motors with Bevel Gear and Series-Multiple Control of Motors" and "Method of Measuring Insulation Resistance of Overhead Lines." Eight pages of forms have been added to Appendix D.

Who Really Invented the Lightning Rod?[1]

An announcement has been made that the names of eminent electricians are to adorn the electrical building at the Columbian World's Fair at Chicago; but if historical precedence be a matter of any moment, one important name has been left out. We have it on the authority of Joseph J. Kral that Procopius Diwisch, a Catholic priest and professor of philosophy at the Lyceum of Luka in the early part of the eighteenth century, was the man who, before Franklin, discovered the identity of lightning and electricity, and the issuing of electricity from metallic points—two important truths which led him to construct a lightning conductor.

The *Encyclopedia Britannica* knows nothing of Procopius Diwisch and the German Lexicon of Brockhaus (vol. v., p. 406) disposes of his two great discoveries in exactly two sentences. The only mention of him that can be found in English literature is a short sketch in the *Historical Magazine* for February, 1868 (art. xii., p. 93), which is a translation from a French periodical. But Mr. Kral has dived into the Bohemian *Encyclopedia* of Rieger and Maly, with the result that he has discovered a mass of presumably authentic data concerning the life and work of this remarkable man, who, while a fervent religionist, found time to become a scholarly scientist. These data are collected in vol. i., pp. 209-210, and vol. iii., p. 941, of the *Encyclopedia*.

We learn that Procopius Diwisch (Dyiv'ish) was born on August 1, 1696, at Zamberk (Senftenberg), in Northeastern Bohemia. In 1720 he took holy orders, and shortly afterward received the professorship of philosophy at Luka. He began to teach physics, with experimental demonstrations—a great innovation for those times. After a rather changeful career, in which at one time he was prior of the Lukan convent (1741), he became a parish priest and settled down at Prendice to the study of electricity. His method of work was essentially experimental. Observations on thunderstorms soon led him to the discovery that lightning was but an electric spark. How thorough his studies were may be gathered from the fact that he worked out a complete theory of atmospheric electricity, a treatise on which was published from his papers after his death. This was entitled "Laengst Verlangte Theorie der Meteorologischen Electricitaet," Tuebingen, 1768.

Another important discovery followed soon after. Diwisch found out that "metallic points would both attract and discharge electricity more speedily than anything else," and he proceeded to make a practical application of the newly discovered truth. About the same time Franklin was receiving his first lessons in electricity from Dr. Spence.

Unusually prompt recognition of his services waited upon Diwisch. The Emperor Francis Stephen invited him to repeat his experiments before him and the Empress Maria Theresa, and rewarded him with two gold medals.

In 1753 Prof. Richman, of St. Petersburg, while observing a storm from a hut, was killed by lightning descending an insulated iron bar specially erected for the purposes of the investigation. Upon learning of the fate of that martyr of science, Diwisch drew up a memoir on the incident and clearly showed how, in case of a storm, the danger of a lightning stroke could be averted by means of a conductor. This treatise he sent to the famous mathematician Euler, then president of the Berlin Academy of Science, asking for judgment. But the Academy failed to understand his reasoning. When Franklin's account of his discovery was read before the British Royal Society, it was laughed at!

However, on June 15, 1754, Diwisch erected the first lightning rod. The construction was as follows: A pointed, slender iron bar formed the main portion of the conductor. Fastened to it were two cross bars, thus making four arms, across each of which, in turn, a shorter bar was laid. Each of the twelve extremities thus produced carried a box filled with iron filings, in which 27 brass needles were stuck, making 324 needles in all. The main bar was supported by a wooden column sufficiently high (48 feet at first, afterward 132 feet) to secure protection for the building and its immediate surroundings. Several iron chains connected the main bar with the earth. The effect of this apparatus was soon demonstrated, thunderstorms being frequent at Prendice.

For two years Diwisch continued experimenting with his lightning rod, the results being published by Dr. Scrinci in the *Prague News* (1754) Having satisfied himself of its utility, Diwisch offered the emperor a plan for erecting a number of conductors; this plan was submitted to the Viennese mathematicians, who reported so unfavorably upon it, that it was never carried out. Abbot Marci, in a letter to Diwisch about this time, refers to the unfavorable attitude of these mathematicians, and tersely puts the whole position in one phrase—"Blasphemant quae ignorant."

At last (1756) Diwisch was compelled to remove his lightning rod. There had been a very dry summer that year, which the farmers of Prendice ascribed to the erection of the rod there. It was consequently removed and deposited at Bruck, where it has been kept to this day. With this treatment compare the action of the Boston clergyman, who, in 1770, preached against lightning rods as "impious contrivances to prevent the execution of the wrath of heaven."

Thus Diwisch was prevented from perfecting his lightning conductor, and from seeing its adoption in his native land. After this episode he turned to music, and invented a new instrument, which he named "Denis d'or," and which was a kind of organ. He died on December 25, 1765.

[1] From the London *Electrical Review*.

Undoubtedly Diwisch knew nothing of Franklin, and there is no evidence that Franklin ever heard of Diwisch; their discoveries in electricity were wholly independent of each other. But Franklin found a people who understood him—the French; while Diwisch, by reason of his social position, was prevented from developing his idea. Again, Benjamin Franklin was a public man, who stood conspicuously before three countries, while Procopius Diwisch was merely a parish priest of a small Bohemian village, with few connections.

An epitaph, written by one of Diwisch's contemporaries, wittily refers to the two inventions of this remarkable man:

Ne laudate Jovem, gentes! quid vester Apollo?
Iste magis deus est fulminis atque soni.

Which may be rendered—

Do not praise Jove, nations! What is your Apollo?
This man, rather, is a god of both the lightning and the sound.

To Light Chicago's Water Front.

In its closing hours the last Congress made an appropriation of $20,000 for lighting Chicago's water front by electricity. It was suggested that this work should be done according to the system used at Sandy Hook. The matter was referred to Capt. Schley, for his views upon the subject. In a communication addressed to the Light-house Board Capt. Schley says:

It would not be possible to employ the system used at Sandy Hook, because it would require too much wire and too heavy voltage to reach the buoy from the point where the system would take hold of the source of power on shore. Two plans are therefore suggested. The first plan is the laying of four single-armor, three conductor cables from a subway on shore parallel to the line of buoys carrying a two conductor cable, insulated and covered with lead. These cables connected with the subway running out to the position boxes near the line of buoys, would include three buoys in the work of each cable. To construct this system would cost $16,000, not including the cost of laying buoys with fittings, 100 candle power lamps or lanterns, and expenses of transportation to Chicago. The second plan, and the best would be to run separate lines of single conductor, single armor, from a two-conductor cable covered with lead and placed in a subway along the beach directly to each buoy of the system. This plan, which is the most feasible, practicable and least expensive, would require about seventeen and one-half miles of cable and would cost $13,000. Other expenses for equipment and maintenance would not exceed $5 000, leaving a margin of $2,500 for laying the subway cable in Chicago.

Ruling Affecting Telephone Patents.

A ruling upon the validity of patents granted in the United States under foreign patents of the same invention was made by the Supreme Court at Washington, D. C., March 27th in the case of Henry Huber and others against the N. O. Nelson Manufacturing company, appealed from the Circuit Court for the Eastern District of Missouri. The opinion was delivered by Justice Blatchford. A patent was issued on April 7, 1874, in Great Britain to the patentee, who assigned to James E. Boyle. The patent was to run for fourteen years, with a proviso that if a stamp duty of £100 was not paid within seven years of date of issue, the patent would, at the expiration of that term, become void. Application for a patent in the United States under the assignment was made November 29, 1881, and the patent granted June 27, 1882. Boyle then assigned to Huber. The £100 stamp duty was not paid in Great Britain within the time required, and the patent there became void April 7, 1881. Under these facts the Circuit Court held that the patent granted in the United States was void because it was granted after the British patent had ceased to exist, and judgment to this effect in favor of the defendant was affirmed.

Justice Blatchford called attention to a decision of the Supreme Court, March 24, 1890, in which it was held that a United States patent ran for the term for which the prior foreign patent was granted, without reference to whether the latter patent became lapsed or forfeited after the grant of the United States patent by reason of the failure of the patentee to comply with the requirements of the foreign patent law. "But that case," said the justice, "did not distinctly cover the present one, because in that case the foreign patent was in force when the United States patent was granted."

A most important result of this decision is called to public attention by the Patent Office. This action, it is said, destroys Edison's quadruplex telegraph patent, and also his three microphone patents, leaving the Bell company, after January next, to stand wholly on the Berliner patent.

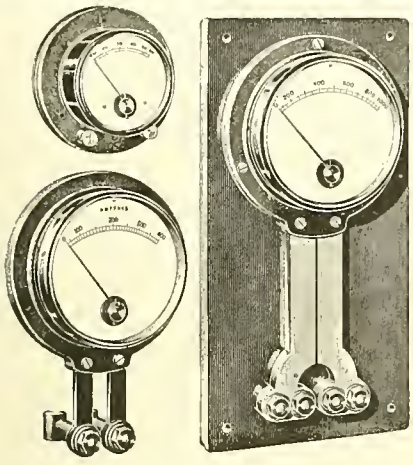
Estimated at $800,000,000.

In an article in the last number of the *Engineering Magazine* on "A Decade of Marvelous Progress," Richard H. Edmonds says:

In the decade under review [1880–1890] a new industry of vast magnitude was created. Twelve years ago electricity as applied to street cars, for power purposes of all kinds, for house and street illumination, was a new thing. In fact electric street railroads have only been in successful operation about half of that time. The electrical age was practically just commencing, and the aggregate capital invested outside of telegraphy was small. Now almost every town of any size has its electric railroad, streets everywhere are being lighted by electricity, and electricity furnishes power for factories, to run elevators, and for many others purposes; still we have scarcely seen the beginning of electrical development. Already, however, the capital invested in all branches of this industry—and nearly all invested since 1880—is estimated at $800,000,000.

English Station Instruments.

The accompanying cuts illustrate the new line of high class instruments that has just been imported by the Central Electric company, Chicago. These instruments are manufactured by W. T. Goolden & Co., of Woodfield Works, Harrow Road, London, W., under the Evershed patents. Without going into details it may be stated that these voltmeters and ammeters are strongly made and are fixed to a small frame, entirely independent of the wood or metal case. The axle, needle and weight or spring are screwed and soldered together, and pivoted in jeweled centers in a brass plug-piece to which the attracting blocks of iron are screwed and soldered, thus eliminating a frequent source of error in measuring instruments. Every instrument is calibrated throughout the entire range and the scale divided by a purely mechanical device, insuring freedom from scale errors. After completion the instrument is compared with standards and only passed into stock for sale if its maximum error is within a prescribed limit. The manufacturers state that these instruments may be left continuously in circuit at the highest reading of the scale without the slightest risk of overheating. Referring to the illustration, Fig. 1 (which is in the upper left hand corner) shows the appearance of the G, K and L classes of instruments. These devices have silver dials and are mounted on polished teak bases. Class G is for direct current work, while the other two classes are intended for use with alternate currents. Instruments of the classes E and B are shown at the lower left hand corner in Fig. 2, class E of this type of meter has a 7 inch enamelled dial, with bronzed metal base. This type is a gravity instrument and is used for direct current work only. Class B meter is a 7 inch silver dial, lacquered brass base, and is made as a gravity or marine instrument for



FIGS. 1, 2 AND 3. ENGLISH STATION INSTRUMENTS.

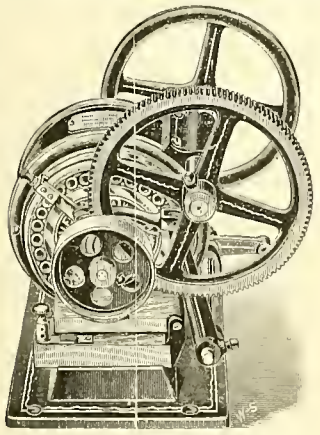


FIG. 1. NEW MESTON MOTOR OUTFIT.

direct currents only. Fig. 3, which is at the right in the cut, shows the class B Evershed gravity ammeter for heavy currents. This ammeter will indicate as high as 1,000 amperes. It is mounted on enameled slate base, 20½ inches by 10½ inches.

New Meston Motor Outfit.

The accompanying illustrations show two recent adaptations of the 1-8 horse power Meston alternating current motors for power purposes. The single motor is geared with a small rawhide pinion to a countershaft as shown, with a proportion of one to nine, giving a maximum speed of 280 revolutions per minute on the countershaft, which in many cases is decidedly preferable to belting from a speed of 2,500 on the motor shaft. The countershaft and gearing are carefully designed to transmit the power with the least possible friction, and the motors have been found to be more effective for power in this way than belted direct. This single outfit is provided either with the regular hand regulator by which the speed can be varied or direction reversed at will, or with a foot regulator for accomplishing the same result, or with a foot regulator and brake by which the speed can

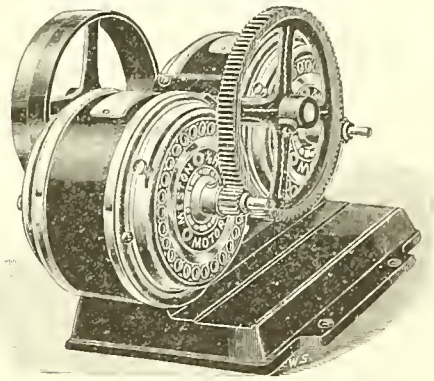
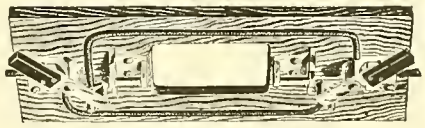


FIG. 2. NEW MESTON MOTOR OUTFIT.

be varied at will, the direction of revolution reversed or the motor stopped instantly. The duplex outfit consists of two 1-8 horse power motors coupled to a single countershaft. They are each supplied with an independent regulator or with a connected hand regulator and brake, but are not furnished with a foot regulator. These outfits are especially designed for use where small power motors are wanted on alternating circuits. The motors are the regular Meston fan motors, which have been on the market for three years. The Emerson Electric Manufacturing company, the manufacturer of the Meston outfits, also has a new alternating dental outfit about ready for the market. The Electric Appliance company, Chicago, is the general western agent for the Meston fan motors and outfits.

New Ceiling Board.

Those who have had anything to do with indoor arc lamps have felt the need of a high grade hangerboard and one which at the same time has a reliable switch. To meet this want Alex. Dow of Chicago has designed a new form of board which has a number of novel features. Perhaps its most striking point is that of having two switches, either one of which will turn off the lamp; while both together disconnect the lamp entirely from the circuit, thus making it safe for the trimmer to handle all parts of the lamp. The hooks on which the lamp is hung are extended so as to form terminals of the switch, all parts of which are strongly built. The board itself has a central opening so as to admit the chimneys or tubes, and can be had in either oblong or round forms. Another neat point is the arrangement of two sets of slots in the binding clamps, so that the wire can either be inserted as shown in the cut or can have its end bent at right angles before entering the clamp. The latter



NEW CEILING BOARD.

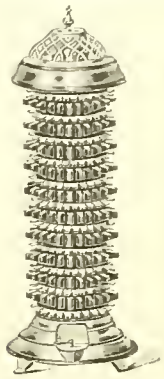
method is preferred by many as it allows the wire to be drawn taut without pulling it out of the clamp. All told, the Dow hangerboard is probably as neatly designed and well built a ceiling-board as has yet been devised. It is placed on the market by George Cutter of Chicago.

Burton Electric Heater.

A new electric stove, suitable for heating stores, offices, and residences, made under the Burton Electric company's patent, and placed on the market by Taylor, Goodhue & Ames of Chicago, is herewith illustrated. This stove is 36 inches in height, resting on a handsome nickel plated base, with a nickel plated top. The radiating surface is broken up into numerous small projections, with the result, it is claimed, of making it a rapid heater, and, as compared with other similar devices, an economical consumer of current. The connections are made underneath the stove. This heater is provided with a switch, by which the degree of heat may be regulated. Moderate heating will consume from 5 to 7 amperes of current on a 110 volt circuit, while in cold weather the heater will consume from 15 to 20 amperes. At the latter point the stove generates heat very rapidly and water may be boiled within a few minutes. Underneath the nickel plated top is a flat surface upon which anything may be placed for warming or boiling. The stove itself is a hollow cylinder, and, as the castings are of thin metal, it takes but a short time for heat to generate.

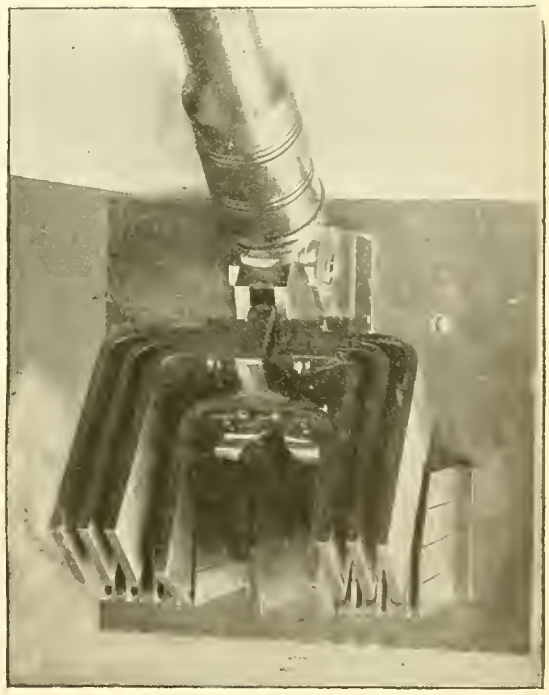
Three Thousand Ampere Ajax Switch.

In the accompanying cut is shown a 3,000 ampere single pole, double break Ajax switch manufactured by C. S. Van Nuis of New York for the Calumet Electric Street Railway company, Chicago. This is said to be the largest switch ever manufactured. The Detroit Electrical Works is equipping the Calumet station. It will furnish



BURTON ELECTRIC HEATER.

eight 100 kilowatt multipolar generators and switch-board for ten generators of the capacity mentioned and eight feeders. The switch-board will be of white marble and will be equipped with Detroit Electrical Works ammeters and limit switches, Weston voltmeters and Ajax switches. Each generator will have a separate section equipped with ammeter, limit switch, high and low potential bus switch, Ajax triple pole switch with fuses, and hand regulator. Each feeder will have a separate section which will be equipped with ammeters, limit switch, high and low potential bus switch, single pole, double break Ajax feeder switch and Wassoo



THREE THOUSAND AMPERE AJAX SWITCH.

station lightning arresters. In the center of the board will be a main section, upon which will be mounted one 3,000 ampere meter potential switch for connecting voltmeter to any generator or bus bar, and a 3,000 ampere single pole double break Ajax switch, this being the largest switch of this description ever manufactured.

The Colchester, Ill., Light & Power company will enlarge its plant.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 1.—Several bills have been introduced in the Legislature of this state, which, if passed, will seriously effect the electrical interests. One of these, the telephone bill, which is urged by a large proportion of the telephone subscribers of the state, has found a resting place in a committee of the Senate, and thus far the efforts of its advocates to resurrect it have been unavailing. Another bill, which should arouse the opposition of every station manager in the community, proposes to regulate the prices for electric current throughout the state. The absurdity of such a proposition is apparent to every one familiar with the subject, but the ludicrous aspect of the case does not appeal to the legislators, who have no knowledge of central station practice or the conditions affecting the cost of generating and supplying current. There may be some excuse for the consideration of this bill by the Legislature in the fact that the members are not familiar with the industry which they are endeavoring to regulate, but there is no excuse for the measure, which was introduced by Assemblyman Cahill, to fix telegraph rates. It is proposed to limit the price of day messages of ten words and night messages of twenty words to 15 cents "for all distances." Such an act would be plainly unconstitutional, inasmuch as the Legislature of New York has no power to regulate the price of messages between points in that state and other states. It should be borne in mind that the telegraph companies come under the class of common carriers of messages; that their business between different states is subject only to the regulation of Congress, as it is interstate commerce, and in the case of the Western Union Telegraph company, which controls most of the lines in this state, this is especially applicable, as Congress has conferred upon it certain privileges and powers, the acceptance of which by the company involves the assumption by the company of certain obligations to the federal government and places it beyond the restriction or interference, in this respect at least, of the state Legislature. Every member of the state Legislature should be familiar with the constitution of the United States as well as the state of New York, but it is obvious that many of our lawmakers are sadly deficient in this respect.

The threatened strike of Brooklyn motormen will probably be avoided. Since the operation of the trolley on the Flatbush avenue line the motormen and conductors have been obliged to make eight instead of six trips, as formerly, and they complained that delays were so frequent that they had no time to get their meals. President Daniel F. Lewis returned from his bridal tour on Tuesday morning in a pleasant frame of mind, and when told of the trouble on the Flatbush avenue line said: "Any differences that may exist between the men and the company will be quietly adjusted to the satisfaction of the men. I can readily understand why the men may object to making eight trips a day when they have hitherto made only six trips, but the agreement we entered into with them at the beginning of the year called for ten hours on the rail, and the number of trips to be made was not stated. If the men under the present system have no time for meals, I will see that it is remedied."

The Atlantic Avenue Railroad company of Brooklyn has contracted with the Westinghouse Electric & Manufacturing company for 400 electric motors for its new trolley cars. The order is said to be the largest of its kind ever placed.

The New York Telegraph Operators' Dramatic and Literary association, which was organized recently, will give its initial entertainment and reception at the New Central Opera House, East Sixty-seventh street, Friday evening, April 14th. The comedy drama, "Tom Sawyer," as adapted from Mark Twain's book of that name by Martin J. Dixon, will be presented.

On Tuesday last the judges in the telegraphers' tournament, held at Hardman Hall last Saturday, gave out the names of the successful contestants. The medals offered by John W. Mackay for the operator who best received messages for an hour were won by B. S. Durkee of Portland, Oregon, who took the first medal with a percentage of 96 36 and by J. H. Jones of San Francisco, who took the second. His percentage was 96 16. P. J. Faulkner of New York was third, with 95.29 to his credit.

In Class A, for senders and receivers for five minutes, the senders who were successful were L. D. Moore of New York, first, and R. C. McCready of Philadelphia, second. The successful receivers were C. L. Hays of New York, first, a copy being called perfect; H. B. Logan of New York second, with one error.

In Class B, sending and receiving five minutes straight, J. D. Hennessy of the Commercial Cable took the first prize for senders, with a record of 238 words and 3 errors, and Frank English the second, with 239 words and 5 errors. Of the receivers E. H. Curlette took the first prize, with perfect copy, and J. H. Jones of San Francisco the second prize, with one error.

In the Phillips Code class C. B. Squires of New York took the first prize, sending 500 words in 7 minutes 45 seconds, and E. H. Curlette of New York the second, his 500 words being sent in 8 minutes 7 seconds. The successful receivers in this class were C. L. Hays, first prize, and H. P. Logan and G. P. Howe of New York divided the second.

The championship of the world for sending was given to F. J. Kihm of New York, who sent 248 words in five minutes without an error. F. L. Catlin took the second prize with 248 words and two technical errors.

Mr. Kihm made periods at the end of two paragraphs, and Mr. Catlin did not, and the difference in the work of the two was so slight that this little matter decided the point. In the receivers, H. B. Logan received the first prize with perfect copy, and J. M. Winder second with one error. W. F. O.

Northwestern Notations.

MINNEAPOLIS, April 1.—The announcement that President Lowry had agreed to put in a second interurban electric line via St. Anthony Park now appears have been somewhat premature. What he has agreed to do, on certain conditions, which it is said have been compiled with, is to make the connection between the terminus of the Como line in Minneapolis and that of the St. Anthony Park line from St. Paul. This does not necessarily mean a through regular interurban service. The line from the Park through Hamline is a roundabout one. It is intended to connect the Como avenue line from Minneapolis and the proposed Como Park line from St. Paul, and thus make a fine interurban line. There is another scheme for interurban service in the movement which has been started in the Legislature for the two cities to unite in building a bridge across the Mississippi river, striking over into the Soldiers' Home and Minnehaha Park region on the Minneapolis side. There is an electric line now from Minneapolis to Minnehaha Falls, and a connecting link with a suburban St. Paul line would be an easy matter. Such a line will probably be built some time, with a line shooting across West Minneapolis to the region of Lakes Calhoun and Harriet. These two towns are slowly but surely coming together, and electricity is doing more than any one thing to tie the knot.

Papers have been filed whereby the Winona, Minn., General Electric company absorbs the plants of the street railway and electric light companies. The erection of a big power house will be proceeded with at once. The Northwest General Electric company controls the Winona company, it is understood.

The Western Union Telegraph company has obtained a favorable report from the council committee on its petition for permission to lay its own conduit along Third street in St. Paul.

W. E. J. Deming, electric wire inspector in Minneapolis, has made a good suggestion in regard to his office, viz: that it be conducted upon a civil service basis. He suggests that the Legislature make provision for an examination of candidates for this office, and the idea has been kindly received.

After numerous debates, the Minnesota Legislature has concluded not to attempt to regulate the charges made by telephone companies. A committee report recommending indefinite postponement has been adopted. A bill to regulate fares for standing passengers on street cars met the same fate.

President Lowry has ordered 105 cars from the American Car company and 60 from the Laclede company of St. Louis. Twenty-five of them will be 40 feet long, for service on the interurban line, and the rest 27 feet 9 inches. They are expected here May 1st.

A bill has passed the Minnsota Senate empowering cities to issue bonds for electric lights. N. L. P.

NEW INCORPORATIONS.

Neshobe Electric company, Brandon, Vt.; capital stock, $20,000; installing and operating systems for the production and distribution of electrical engineering.

Pekin Rapid Transit company, Pekin, Ill.; capital stock, $100,000; to build and operate electric street railway in Pekin, Ill; A. E. DeMange, Bloomington, Ill.

Hartford Electric company, Hartford City, Ind; capital stock, $30,000; to manufacture and furnish electric current for heat, light and power; A. Reynolds, Hartford City, Ind.

Essex-Hudson Light & Heat company, Newark, N. J.; capital stock, $2,000,000; to manufacture, purchase and sell machinery and materials required to be used for making and using gas and electricity for light, heat, power and all other purposes, etc.; McCarter, Williamson & McCarter, Newark, N. J.

Safety Steam Appliance company, Portland, Maine; capital stock, $25,000; to manufacture and deal in all kinds of steam electrical machinery; W. J. Knowlton, Portland, Maine.

Edison Electric company of New Orleans, New Orleans, La.; capital stock, $500,000; to generate, manufacture, use, utilize and employ electric light, power and electric apparatus and appliances.

Electric Transit company, Camden, N. J; capital stock, $100,000; to make, buy, sell and operate electric and other machines and appliances for railways, etc.; King & Smith, Camden, N. J.

Chicago Metropolitan Gas company, Chicago, Ill.; capital stock, $5,000 000; to manufacture and sell gas or electricity for all purposes; John H. Miller, 87 Washington street, Chicago, Ill.

Montana Telephone company, Stevensville, Mont.; capital stock, $30,000; to operate system of electric telephone lines in Montana, and establish messenger service in connection therewith.

Fryeburg Manufacturing company, Fryeburg, Maine; capital stock, $25,000; to manufacture and deal in all kinds of lumber, furniture, machinery, electricity, etc.; E. E. Hastings, Fryeburg, Maine.

Sachs Electrical company, Jersey City, N. J.; capital stock, $100,000; manufacturing and selling under letters patent, licenses, or otherwise electrical apparatus, etc; F. Forbes, 137 Broadway, New York, N. Y.

Union Multiplex Telegraph company, New York, N.Y., and Helena, Mont.; capital stock, $20,000,000; constructing lines of electric telegraph in Montana and elsewhere and manfacturing necessary machines and apparatus.

Scranton & Abington Street Railway company, Scranton, Pa.; capital stock, $100,000; constructing and operating an electric railway from a point in Scranton to other points in Lackawanna county; J. Alton Davis, Scranton, Pa.

Dayton Traction company, Dayton, O.; capital stock, $200,000; building a street railroad in Dayton, Montgomery county, and Miamisburg, O., to be operated by steam, horse or other motive power; Gottschall & Brown, Dayton, Ohio.

Hillsborough Electric Light & Power company, Hillsborough, Ill.; capital stock, $18,000; to operate electric light and power plant in Hillsborough, Ill., and neighboring towns; William Wurdack, 809 South Seventh street, St. Louis, Mo.

Cleveland Electric Railway company, Cleveland, O.; capital stock, $6,500,000; consolidation of the East Cleveland Railroad company and the Broadway & Newburgh Street Railroad company; Squire, Sanders & Dempsey, Cleveland, Ohio.

Chicago, West Ridge & Waukegan Electric Railway company, Chicago, Ill.; capital stock, $1,500,000; to construct and operate an electric street railway from Chicago north to Waukegan and the state line in Illinois; James Hibben, 904 Chamber of Commerce, Chicago, Ill.

Superior Electric company, Chicago, Ill.; capital stock, $300,000; to manufacture, deal in and lease electric motors, dynamos, machines, supplies and appliances of all kinds, conduct general business, dealing in same throughout the United States and elsewhere; James L. Clark, 507 Tacoma building, Chicago, Ill.

Marion City Railway company, Marion, Ind.; capital stock, $500,000; building, owning, maintaining and operating a street railway, light, heat and power plant in Marion, Gas City, Jonesboro and vicinity, and connecting these cities and other places by street railway; to furnish light, heat and power for public and private use; W. H. Carroll, Marion, Ind.

ELECTRIC LIGHTING.

Galva, Ill., will be lighted by electricity.

Massillon, O., has decided to put in an electric light plant.

Ripon, Wis., contemplates putting in an electric light plant.

An addition is to be built to the electric light plant at Wellsville, O.

Four Joliet, Ill., capitalists have organized an electric light company and will put in a plant.

The question of establishing an electric light plant for lighting the city of Falmouth, Ky., is being agitated.

The plant of the Electric Light company at McKeesport, Pa., has been destroyed by fire; loss, $100,000.

Plans have been submitted for lighting the town hall of Fairhaven, Mass, by electricity; 463 lights will be used.

A proposition is to be submitted to the people of Anna, Ill., to authorize the issue of $1,000 of bonds to light the town with electricity.

The Pontiac, Ill, Electric Light, Heat & Power company, capital $40,000, has been incorporated. Henry A. and A. P. Foster and C. M. Hamilton are the proprietors of the enterprise.

The Kansas City Electrical Works will build a power plant and erect poles and wires for lighting the territory bounded by Eighteenth street, Springfield avenue, Main street and Woodland avenue with arc and incandescent

lights. The company agrees to furnish all night arc lights to the city for $8 per month and incandescent street lights of 32 candle power for $2.50 per month each.

The Orange City Electric Light company, Orange City, Ia., contemplates extending its wires to Alton to light that town with electricity.

An ordinance has been introduced in the city council of Tacoma, Wash., authorizing the city to issue $200,000 of bonds for an electric light plant.

The Capital City Electric Light company of Madison, Wis., has purchased a site for a station in which it will place a 200 arc and 1,200 incandescent light plant.

An electric light and power company will furnish the towns of Toledo and Tama, Ia., with light and power. An electric street railway is to be operated between the two towns.

The Des Moines Water Power & Electric Light company and the Des Moines Edison Light company have consolidated under the name of the Des Moines Electric company.

The Industrial Council of Kansas City, representing fifty-two labor organizations, has sent a communication to the mayor and city council indorsing the proposition to secure a municipal lighting plant.

The plant owned by the Mount Vernon, N. Y., Electric Light & Power company was destroyed by fire a few days ago. All the engines and dynamos were ruined. The loss was $12,000, partly covered by insurance.

The Catskill, N. Y., Illuminating & Power company (the Thomson-Houston Electric Light company) has absorbed the Catskill Gas company, a concern that has done business ever since 1858. The gas company sells its plant and franchise and the exclusive right to manufacture and sell illuminating gas in Catskill.

The Chicago & Western Indiana Railroad company is about to install an arc light and power plant for the purpose of lighting its tracks, yards and buildings in Chicago at a cost of about $70,000. The building will be equipped with machinery of the most modern design, including seven boilers of 300 horse power each.

The McKeesport, Pa., Electric Light company's plant was destroyed by fire on March 31st. The fire was caused by a torch in the hands of an oiler coming in contact with a bunch of oil-soaked waste, which communicated the flame to an oil barrel which exploded, scattering the fire in all directions. The loss will be heavy.

On March 29th an application was made to the commissioners by the representatives of a new electric company for permission to lay underground conduits in Washington. It is claimed for the new company that the district will save about 50 per cent. if the new company is given the lighting of the city. The commissioners encouraged the projectors of the enterprise to organize and then bring the matter of the streets before the full board.

J. C. Christman of 507 Forty-second place, Chicago, is at the head of a move to secure, if possible, a reduction in the rate at which electric lights are furnished merchants in the town of Lake. He has a petition signed by a number of property owners, which is now in the hands of a council committee. "What we object to," said Mr. Christman, "is paying a higher rate for our lights than is charged in other parts of the city. We are compelled to pay 40 cents for each arc light per night, and this on condition that we turn off the light at 10 o'clock. In Hyde Park, Kensington, South Chicago and other suburbs better lights are furnished until midnight for 25 cents each."

ELECTRIC RAILWAYS.

Quincy, Ill., capitalists will build an electric railway to Pittsfield.

An electric car line between Sidney and Piqua, O., is projected.

Leavenworth, Kan., is to have an electric railway in the near future.

An electric street railway is projected from Herkimer, N. Y., to Ilion.

An electric railroad is contemplated by the Salem, Odin Sandoval and Centerville, Ill., people.

An electric road will be built from Westchester, O., to Downington, a distance of seven miles.

The Miami Valley Railway company has been organized to build an electric road in Sidney, O.

A company has been organized to construct an electric railway from Springfield, Ill., to Winchester.

The electric railroad in Hommelstown, Pa., is to be extended to the Stovedale camp-meeting grounds.

The Leavenworth, Kas., Street Railway company will at once begin the construction of an electric street railway.

An electric line nearly 100 miles in length is to be built from Scranton, Pa., to Northumberland, traversing five counties.

An electric street railway is to be constructed from Bellaire, O., to Beaver Falls, Pa., and also to Newark and Zanesville, O.

The Frankford & Southwark, Pa., Passenger Railway company is about to experiment with a storage battery system. One of the abandoned storage battery cars formerly used on the Lehigh avenue branch of the road is being fitted up with the new system, and will be ready for public trial in about one month.

A company composed of New York capitalists has been granted a franchise for an electric street railway in Hagerstown, Md.

The car house of the Newark & Orange Electric Railway company at Roseville was burned on April 3rd. The loss will reach $150,000.

The Kalamazoo, Mich., Electric Street Railway company will extend its lines in four directions, franchises having been granted by the city council.

The Woonsocket Street Railway company of Woonsocket, R. I., will increase its capital stock to $400,000 to enable it to extend its service and use electric power.

The Columbus & Harrisburg Electric Street Railway company will build an electric railway line three miles in length, and also a telephone line along the route of the road.

The Denver, Lakewood & Golden Railroad company has been granted a franchise for the right of way from the West End Electric line in Colfax, Colo., to the Lakewood track.

Peru, Ind., has authorized the construction of an electric road by the Peru Railway company, the company also to furnish electricity for illuminating, power and other purposes.

Cleveland and New York capitalists have organized a street railway company to operate in Columbus, O., with a capital of $1,500,000. Twenty-six miles of track will be operated.

The Springfield, Jacksonville and Winchester Railway company has been organized to construct a railway from Springfield, Ill., through Winchester, Scott county, to Jacksonville.

The Dartmouth & Westport Street Railway company of Dartmouth, Conn., will build an electric line to Smith Mills. The company has given bonds of $10,000 to complete the road by January 1, 1894.

The Bloomington & Normal company will expend $750,000 in building an electric railroad from Bloomington, Ill., to Lexington, a distance of twenty miles, and from Bloomington to LeRoy, a distance of 20 miles.

J. K. Jolly of Pittsburg, Pa., will build about ten miles of electric railroad from Bellaire to Martin's Ferry, W. Va. Girder rails will be used, and a first-class road will be built. An electric railroad is now running between Martin's Ferry and Wheeling.

The Allentown & Pennsylvania Trunk Trolley company contemplates extending its electric lines from Norristown, Pa., to Lehigh, Bucks and Montgomery counties. Ex-Mayor Grace, of New York, is the president of the company, which is capitalized at $1,000,000.

The Pen Argyle, Bangor & Water Gap Electric company of Pen Argyle, Pa., will build a road from Water Gap to Pen Argyle, West Bangor, East Bangor, Johnsonville, Williamsburg, Middlevillage, Shortland and through Delaware Water Gap to East Stroudsburg.

The Mt. Victory, O., Electric Light & Street Railway company (capital stock, $40,000) has been incorporated. It will build a street railway from Mt. Vernon to Gambier. The company also contemplates the construction of an electric railway through Fredericktown to Marion.

At the annual meeting of the stockholders of the Short Electric Railway company at Cleveland the following named officers were chosen for the ensuing year: President, B. F. Miles; vice-president, S. H. Short; general counsel, W. B. Bolton, general manager, S. M. Hamill; directors, S. H. Short, W. H. Lawrence, M. T. Herrick, W. B. Bolton, B. F. Miles, James Parmelee, S. M. Hamill.

Construction work on the Chicago and St. Louis electric railway has been resumed, and it is intended, by pushing the work, to have a portion of the line in operation by August. The contractors have agreed to finish the entire road within a year at a cost of $5,500,000, and it is understood that operations will be begun at ten different points at once. The General Electric company has announced that it is ready to equip the entire line with the multiphase system and guarantee that a speed of 100 miles an hour can be attained with safety.

At the power house of the Electric Street Railway company of Lowell, Mass., recently, an iron pulley on a dynamo burst and one of the flying pieces struck the fly-wheel of the engine, smashing it instantly. The flywheel was 20 feet in diameter, with an iron rim 3 inches thick, and was making 72 revolutions per minute at the time of the accident. Pieces of the wheel were hurled through the roof and went to a distance of 100 yards. One section of the fly-wheel, weighing a ton, crashed through the walls of the engine house and through the brick walls of the repair shop adjoining. One piece of the wheel, weighing nearly as much, was thrown on to the Boston and Lowell tracks. A. H. Mead, assistant engineer, was struck on the head by a piece of iron and died in a few minutes. Geo. Langly, an oiler, had his jaw broken. All the electric cars in the city were stopped until another dynamo and an engine could be started up, which occurred an hour later.

The Philadelphia Traction company is perfecting plans to rebuild the Market street cable line as soon as the weather will permit. It is believed that the cable system is to be abandoned and a trolley line arranged for on the principal thoroughfare. There is some talk of inducing the company to introduce an underground trolley system and utilizing the conduits already laid. The Traction company is now making application to the legislature to increase its capital stock to raise money for these contemplated improvements. Contracts have already been placed for the construction of the trolley on Thirteenth and Fifteenth streets, Morris and Tasker streets, and Gray's Ferry road. Additional contracts are about to be let for Eighteenth and Twentieth streets, Filbert and Sansom, Woodland avenue, Jefferson and Master, and York and Dauphin streets. The People's Traction company, which controls nearly all the remaining railways in the city, is also after trolley privileges.

TELEGRAPH.

The Edison Mutual Telegraph company, with 560 miles of wire, from Edison, Mich., to Middletown, O., and from Vanwert, O., to Fort Wayne, Ind., was absorbed by the Western Union Telegraph company on March 29th. A number of Western Union officials organized and elected a new board of directors, with R. C. Clowry of Chicago general superintendent of the Edison Mutual Company. The Edison company was captilized at $50,000, but only $20,000 of the stock had been issued, and of this the Western Union secured the majority.

ELECTRIC MINING.

It is proposed to establish an electric plant at Nelsonville, O., which shall be capable of operating all the coal mines within eleven miles. The current will be used to light the mines as well as to operate electric mining machines.

MISCELLANEOUS.

Ishpeming, Mich., is putting in an electric fire alarm system.

On "Christmas pay night" nearly 4,000 employes were in line, waiting for their money, at the Thomson Houston works in Lynn.

The Western Electric company has filed a bill for an injunction against the Potomac Electric company. The bill is based on a judgment for $2,833.18 obtained in February last, and states the company's indebtedness to be over $50,000, which is largely in excess of its capital stock.

H. R. Leavens, T. S. Coolidge, M. O. Brown and E. B. and O. S. Potter of Glens Falls, N. Y., have a scheme on foot to build a dam across the river 30 feet high, put in an electric plant and supply the villages of Glens Falls, Sandy Hill, Fort Edward, Gansevoort, Fort Ann, Saratoga and other neighboring places with electricity for power and lighting.

The first number of the *Electrical Buyers' Reference*, which is described as "a quarterly illustrated descriptive catalogue" intended for purchasers of apparatus and supplies, has just been issued. The publishers announce that in connection with this publication they intend to maintain an "information bureau." The new publication is handsomely printed, and is gotten up in attractive form. It is conducted under the personal supervision of W. J. Hammer, and the first number bears evidence of the care and accuracy which attends his work.

A scheme to supply Seattle, Wash., with electric power from Snoqualmie Falls, 18 miles distant, is being considered by the Parke & Lacy company of Seattle. It is claimed that from 10,000 to 15 000 horse power can be obtained from the falls, which is sufficient to operate machinery and street railways in Seattle and several towns along the proposed line from the city to the falls. A number of Pelton or Dodd wheels will be placed at the foot of the falls. A company will be formed to build and operate the plant, which will require the expenditure of about a million dollars.

The trial of an action brought by the Electric Power company against the Metropolitan Telephone & Telegraph company, which has been pending in New York, resulted in a verdict for $2,565.88. The plaintiff sued for damages caused by the cutting by the telepone company of the plaintiff's wires on the housetops in New York city. The defendent admitted the cutting of the wires, but said it was justified by the orders of the board of electrical control, and also, it claimed, because the plaintiff's wire were dangerous to life and property and amounted to a nuisance.

A press dispatch from Boise City, Idaho, states that the horse market of that state is in a terribly glutted condition. There is absolutely no sale for the animals, notwithstanding the fact that ordinarily good stock is offered at from $8 to $15 per head. Samuel Rich, a wealthy stockman of Bear Lake county, declares that the prevailing dullness in the horse trade is traceable chiefly to electricity. The large cities of the East, South and West have for years purchased many of their street car horses in Idaho, but the horse car has been superseded by electricity and cable cars, and horseflesh is not wanted. Many stockmen say that they propose allowing almost all their animals to run at will until there is a demand for them. If they carry out their intentions the hills of this state will within a few years be alive with wild horses.

James F. Muncie of Brooklyn, reports that his electric railway system at Hartford, Conn., has been thoroughly tested and found satisfactory. Mr. Muncie describes his road as follows: "The feed-wire is laid between the bearing rails, and buried some six inches in the ground above the cross ties, except at the crossing points of the cir-

cuit, where it is depressed below the ties. This arrangement is to prevent expense in excavation. These circuit closing points are placed at intervals of fifteen or twenty feet. The contact point boxes, in which are the insulators and circuit closing apparatus, are depressed. The live points are of course on the level of the street, to allow of the necessary contact. While the car is passing over the contact point the circuit is closed. When it has passed, the circuit immediately opens, leaving the circuit at that point dead and the 'make-and-break' point hermetically sealed. The advantage of this plan is that the live wire is as thoroughly insulated from beginning to end as the most carefully lead-covered cable.

Electric companies will have an interest in a suit which has been instituted as Middletown, Conn., in which will be tested, perhaps by the highest court in the state, the question of the responsibility of electric light and power companies for fire losses resulting from the improper wiring of buildings. Some months ago the Middlesex Theatre, then just finished in Middletown, was badly damaged by a fire originating from some mysterious cause. It was the belief that the electric wires caused the fire. Sheriff Thomas Brown served a writ of attachment on the Middletown Electric Light company in behalf of the the Middlesex Assurance company, which controls the theatre, to recover damages in the sum of $40,000, caused by the partial burning of the building. It is claimed the fire originated through the imperfect insulation of the electric wires.

TRADE NEWS.

The Consolidated Electric Manufacturing company, of Boston, has been granted patents on the Lyon brake for cars.

General Manager B. G. Fiedler, of the Boston Braid company of Boston, is still turning out large orders of his well known silk braid for incandescent lamp filaments.

The Whitney Electrical Instrument company, of Boston, reports the sale of instruments for the month of March as being much larger than that of the preceding two months.

On or about April 15th the Crocker-Wheeler Electric company will move its offices to 39 and 41 Cortlandt street, New York. The factory will also be moved to the company's new property at Ampere (East Orange), N. J.

Col. L. G. Burnham, general manager of the Electric Gas Lighting company of Boston, reports a large demand for the Samson battery. The outlook for spring and summer trade in his line, he says, is unusually promising.

The Backus Water Motor company, Newark, N. J., has issued an illustrated catalogue and price list of its electric fans which is fully descriptive of this company's varied assortment. Instructions for putting up the fans are contained in the pamphlet.

General Manager E. R. Rand, of the Newton Rubber company of Boston, reports large improvement in the electrical part of the business since the first of the year, and the demand for the Newton rubber for all kinds of electrical use is still increasing.

The Samson Cordage Works of Boston recently added one 50 horse power motor, and one 50 horse power dynamo of the Mather type to their well equipped factory. The construction work was done by the Massachusetts Electrical Engineering company of Boston.

The patrons of Taylor, Goodhue & Ames will do well to notice the announcement of removal which has been issued by that firm. On and after May 1st the concern will occupy the store at 348 Dearborn street, Chicago, where it will have increased facilities for conducting its business.

The American Circular Loom company, of Boston, is manufacturing a new canvas-covered wire called cavasite. The principal feature of this wire is that it is very difficult to injure the insulation. The new wire has already gained the confidence of many prominent construction companies.

The Ford-Washburn Storelectro company, Cleveland, O., has issued a circular describing its new electric fan, designed for restaurants, offices, private houses, etc. The fans require no attention, are simple in construction, and can be moved about. Motors are made for arc and incandescent circuits.

Jay Holmes, who for the past five months has been New York representative for the Beacon Vacuum Pump & Electrical company of Boston, has taken an office at 39 Cortlandt street, New York, where he will represent the Jackson Manufacturing company of Harrisburg, Pa., and also be in the electrical supply business once more.

The Electric Appliance company of Chicago has closed arrangements to represent Diehl & Co. in the West, handling a full line of their ceiling and exhaust fans for direct incandescent, street railway or arc circuits. The Diehl fans have been on the market for a number of years and this agency will undoubtedly prove a valuable one to the Electric Appliance company.

The business formerly done under the firm name of the Potter & Leavitt Electric Motor company of Providence, R. I., is now conducted by the Leavitt Motor company. This change was made April 1st. The company will still continue to manufacture small house and desk fans. This company recently installed additional machinery and increased its working force to meet the demands of the growing business.

General Manager W. G. Chase, of the Mason Regulator company of Boston, is sending to the trade a handy illustrated price list in pamphlet form of steam regulating devices manufactured by this company. He is also presenting his patrons a little pocket stamp holder, in the form of a small letter, stamped and addressed to this company. It is quite novel as well as attractive, in the form of a little reminder of this company and what it is offering.

BUSINESS.

The Butterfield-Mitchell Electric Heating company of Boston has been succeeded by the American Electric Heating company. The office is at 274 Purchase street, Boston.

D. W. Davis, representing the Phœnix Iron Works company of Meadville, Pa., is sending out a number of catalogues describing the Dick and Church engine from the Chicago office, 418 Chamber of Commerce building. This catalogue, which was recently referred to in the WESTERN ELECTRICIAN, is a highly creditable production, and will prove valuable to engine men generally.

The contract for furnishing the lighting fixtures of the new Presbyterian church in Bay City, Mich., has been awarded to Macdonald, Rich & Co. of Detroit. The contract calls for one large center chandelier of 60 lights of 16 candle power each, 8 side chandeliers of 12 lights each, 12 bracket lamps of 3 lights each under the gallery, and 2 chandeliers of 12 lights over the gallery.

The Ansonia Electric company (formerly the Electrical Supply company), Chicago, reports a very pleasing reception for its latest specialty, the Helios arc lamp for alternating circuits. The company has just closed a contract for a plant for municipal and commercial lighting, in which a single alternating dynamo is to be used. From one circuit will be run the Helios arc lamps for street lighting, also the incandescent lamps for interior lighting. The Stanley transformers will be used in this connection.

The new power plant of the Alameda Street Railway company, Alameda, Cal., will contain two 150 horse power Ball tandem compound condensing engines, built by the Ball Engine company, Erie, Pa. Four Ball engines will furnish the power for electric lighting on four lake steamers, built by the F. W. Wheeler company, Bay City, Mich. These boats will be the largest on the lakes. The Everett Street Railway company, Everett, Wash., has purchased from the Ball Engine company, Erie, Pa., three cross compound condensing engines, 100, 150 and 200 horse power respectively.

F. W. Horne of the western railway department of the General Electric company, has been doing a thriving business of late. He has recently closed the following contracts: One with the Salt Lake City Street Railway company, for eight double 25 horse power motor equipments; one with the Muscatine, Ia., Street Railway company, for five cars and one generator of 133 horse power; another with the Shreveport, La., City Railway company for one 133 horse power multipolar generator; and he has also made a deal with the New Orleans & Carrolton Railway company for twenty 25 horse power motor equipments.

The Delaware Hard Fiber company of Wilmington, Del., has recently made some interesting tests in regard to the tensile and crushing strength of hard fiber, which illustrates some of the remarkable properties of that material. A sample disk 1½ inches in diameter and 1 inch thick cut from a sheet of fiber was found to crush under a total pressure of 40 tons, which would correspond with a pressure of about 23 tons per square inch. A round rod tested by the Edgemoore Bridge Works broke under a tensile strain of 8,600 pounds per square inch, which closely corresponds with results obtained at the royal technical and mechanical testing department of the German army at Berlin. Three samples which were tested there gave results varying from 8,000 to 9,000 pounds per square inch. Such results as these, it is claimed, can only be obtained from a fiber free from clay or other adulterations.

ELECTRICAL PATENTS.

Issued March 28, 1893.

494,146. Magnetic Lock. Alcuin E. Kintner, Painesville, O.

494,149. Process of Manufacturing Filaments for Incandescent Lamps. Alexandre de Lodyguine, Paris, France.

The filaments are first formed from bamboo, paper, thread or other organic material, and then placed upon formers and subjected to the action of a chemical agent, as fluoride of boron, by which the organic substance is decomposed, leaving only the carbon. The filaments are then subjected to a high temperature, with the exclusion of oxygen, after which the occluded gases are expelled and the filaments coked by subjecting them to a high temperature by the passage of an electric current. Finally, the required resistance is given to each filament by the deposition of carbon.

494,150. Process of Manufacturing Filaments for Incandescent Lamps. Alexandre de Lodyguine, Paris, France.

A filament of organic material is first carbonized, after which an electric current is passed through it in a vacuum to drive off the occluded gases and to coke the filament. The resistance of the filament is then rendered uniform by the deposition of carbon upon it.

494,151. Filament for Incandescent Lamps. Alexandre de Lodyguine, Paris, France, assignor.

The filament is composed of a core or body of electrically coked organic carbon and an external shell of deposited carbon.

494,185. Printing Telegraph. John E. Wright, New York, N. Y.

494,186. Lightning Arrester. Alexander Wurts, Pittsburg, Pa.

A number of condensers are provided, having one side connected to ground and the other connected to plates arranged in a circle and adapted to make connection with a pair of arms when the latter are rotated. One of the arms is connected to ground and the other to the line to be protected. As the arms are rotated the line will be connected to ground through one condenser, whereby any charge upon the line may escape. As the arms are further rotated the condenser is connected to ground and is discharged while a second condenser is connected with the line. Thus the line is kept free from charge during a storm.

494,199. Pyro-electric Battery. Thurston G. Hall, Chicago, Ill.

494,225. Electrical Meter. Gustaf Rennerfelt, Buffalo, N. Y.

Two drums are placed in parallel positions, one being in the shape of a cone and being rotated by clock mechanism, the other in the shape of a reversed cone and connected with the recording apparatus. A small wheel rests between the drums and transmits motion from one to the other, the speed of the reversed cone depending upon the position of the wheel along the surfaces of the drums. The wheel is secured to the plunger of a solenoid through which the current to be measured passes, so that as the current increases the wheel is moved to the proper position to change the ratio of reduction between the cones, so that the proper registry may be made.

494,232. Apparatus for Electrolyzing Copper. Charles B. Schoenmehl, Waterbury, Conn.

494,239. Electrical Excitation of Vacuum Tubes. Harry T. Barnett, London, Eng.

Heretofore it has been impracticable to excite two or more vacuum tubes placed in parallel, as the discharge will always take place across the path of least resistance. Between the ends of each tube and the mains are placed condensers, having an inductive capacity proportional to the minimum sectional area, or to the degree of illumination of the particular tube with which they are combined.

494,258. Stop Motion for Knitting Machines. George J. Manderfield, Royersford, Pa.

494,278. Electric Bell. Frederick W. Manger and Otto H. Huebel, Brooklyn, N. Y.

494,279. Circuit of Electric Signaling. Morris Martin, Malden, Mass.

494,281. Electric Car Fender. Edwin Rochester, Ottawa, Ont.

494,286. Apparatus for Protecting Buildings from Lightning. J. B. L. Bartlett, Boston, Mass.

A net work of wires is dispersed over the roof and sides of the house and connected to ground, the idea being that the wires will receive and discharge the lightning without the assistance of pointed objects.

494,291. Electric Heating Apparatus. Mark W. Dewey, Syracuse, N. Y.

494,295. Induction System of Electrical Heating. Samuel B. Jenkins, Boston, Mass.

494,301. Electrically Heated Radiator. Willis Mitchell, Malden, Mass.

494,337. Electric Annunciating Push Button. John King, Chicago, Ill.

494,344. Controlling Device for Electric Cars. James H. Neal, Boston, Mass.

494,345. Electric Signaling Apparatus. Frederick Pearce, New York, N. Y.

494,348. Electric Lamp Support. Charles E. Richardson, Springfield, Vt.

494,359. Electric Brush. Robert E. Williams, Hot Springs, Ark.

494,385. Telephone and Signaling Circuit. Frank A. Pickernell, Newark, N. J., and Francis W. Dunbar, New York, N. Y.

494,399. Temperature Regulator. Byron E. Van Auken, Chicago, Ill.

494,451. Electrical Switch Lock. Frederic C. Weir and Edward W. Harden, Cincinnati, O.

494,477. Electric Railway. John C. Henry, New York, N. Y.

494,478. Driving Gear for Motors. John C. Henry, New York, N. Y.

494,479. Electric Car Truck. John C. Henry, New York, N. Y.

494,489. Electric Signal, Switch Moving and Interlocking Mechanism. Joseph Ramsey, Jr., and Edward W. Harden, Cincinnati, O.

494,495. Electric Bolt Operating Mechanism for Safes. Emory Stockwell and Herbert C. Stockwell, Stamford, Conn.

494,499. Globe Holder for Electric Arc Lamps. William A. Turbayne, Detroit, Mich.

494,513. Alternating Current Meter. William Stanley, Jr., Pittsfield, Mass.

494,520. Electrical Instrument for Medical Purposes. Benjamin Y. Boyd, Wichita, Kas.

494,525. Block Signal System for Railways. Eugene Fontaine, Detroit, Mich.

494,531. Electric Lamp Vibrator Regulator. Daniel M. Moore, New York, N. Y.

The regulator is adapted to vary the intensity of an incandescent lamp supplied with either an alternating or continuous current. In circuit with the filament and within the bulb is provided a circuit breaker comprising a contact anvil and a spring supporting a piece of magnetic material. In the neck of the lamp is placed an electro-magnet, which is included in series with the filament, and which is adjustable by means of a key, so that it may be made to approach or recede from the piece of magnetic material to attract the latter with greater or less force, thus varying the speed of breaking the circuit, and consequently the brilliancy of the light.

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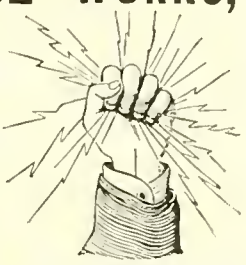

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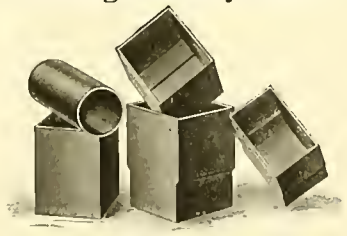

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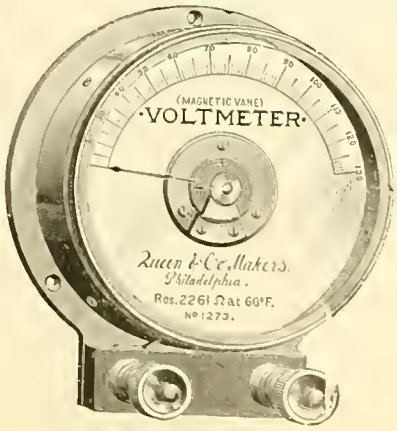

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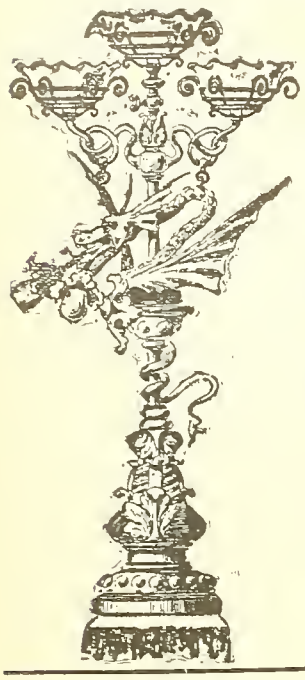

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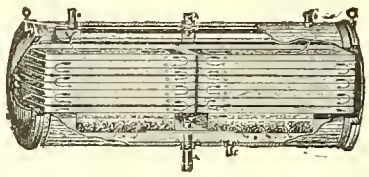

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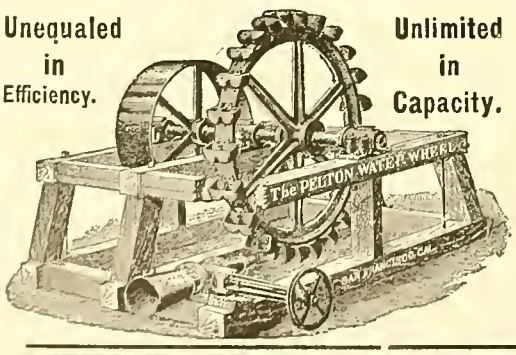

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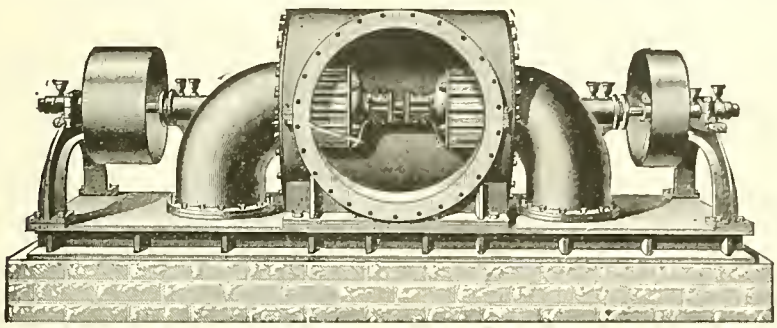

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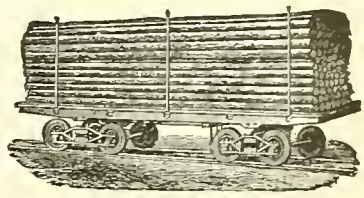

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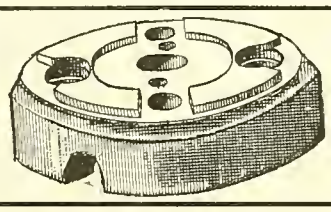

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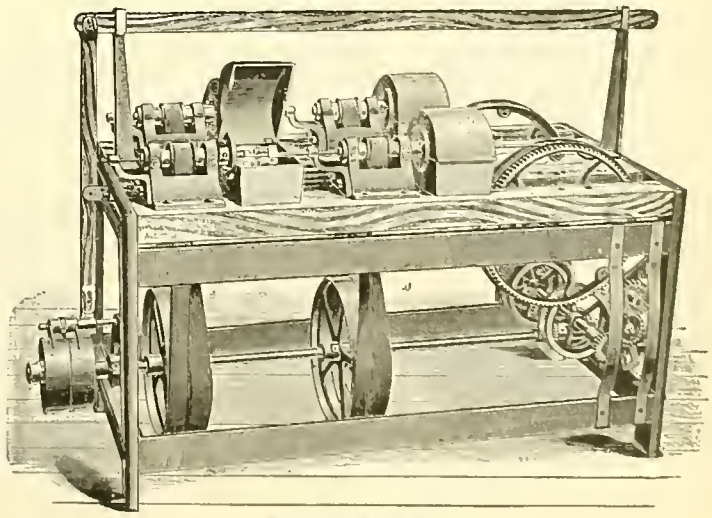

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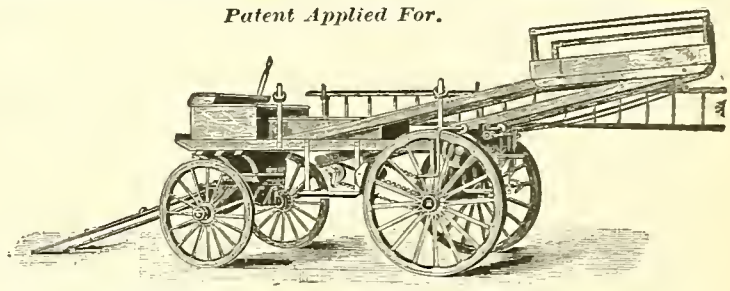

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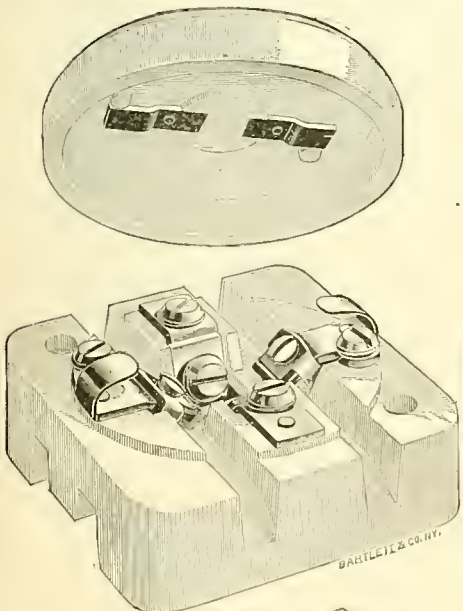

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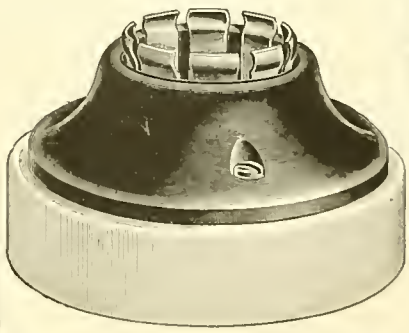

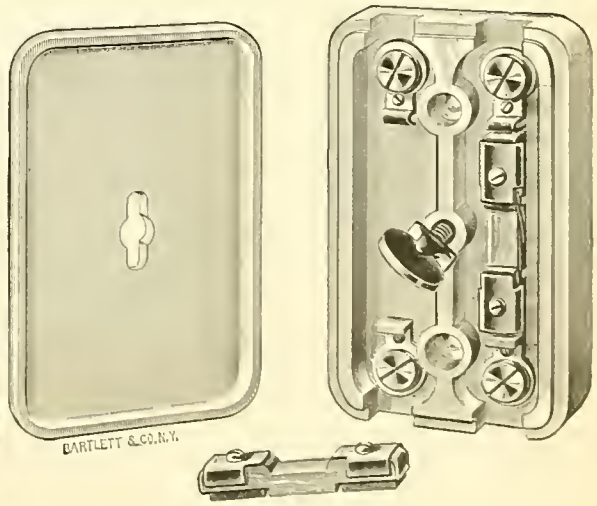

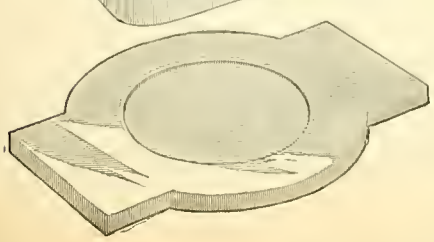

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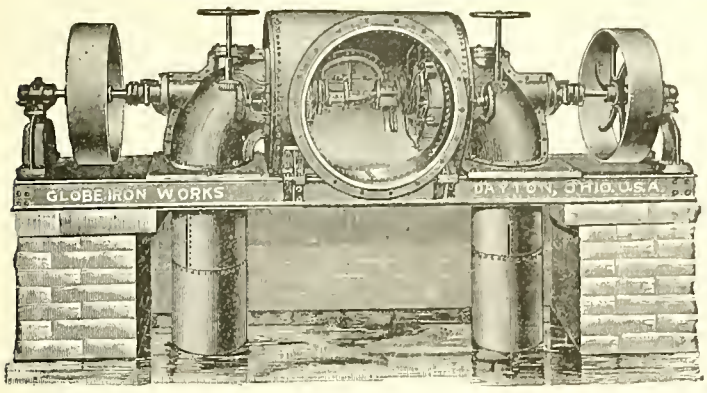

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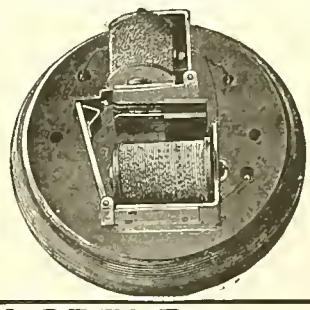

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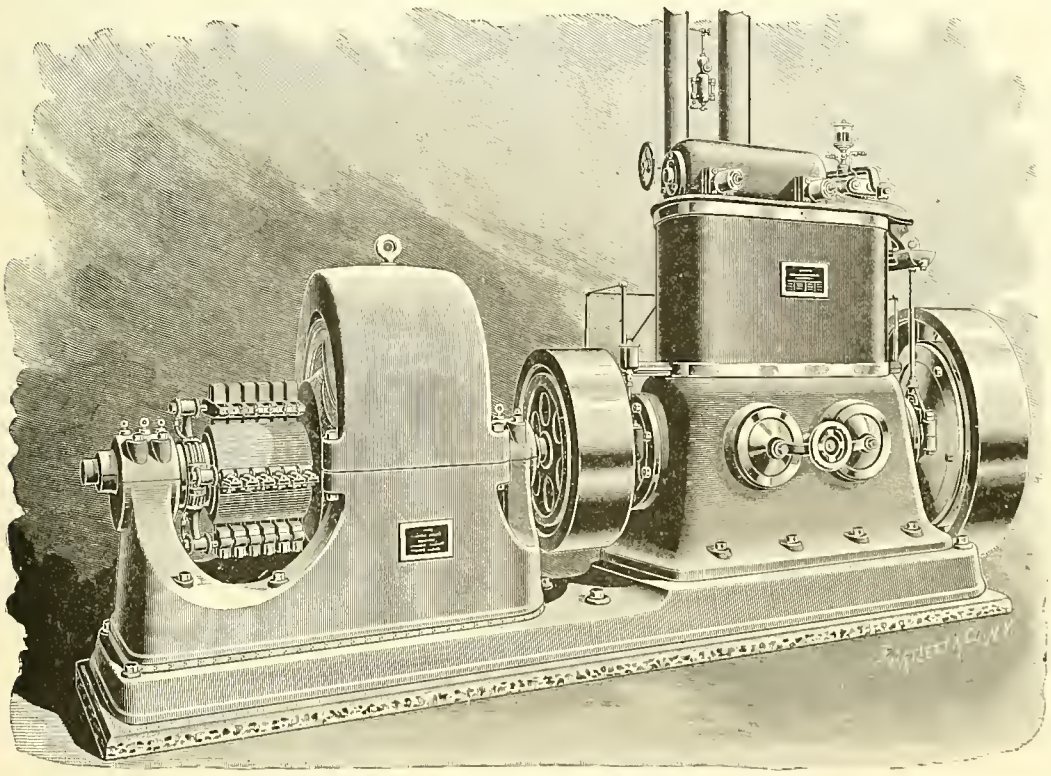

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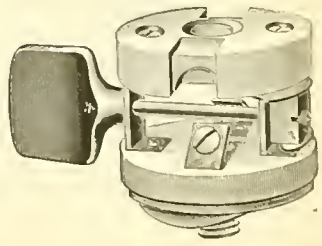

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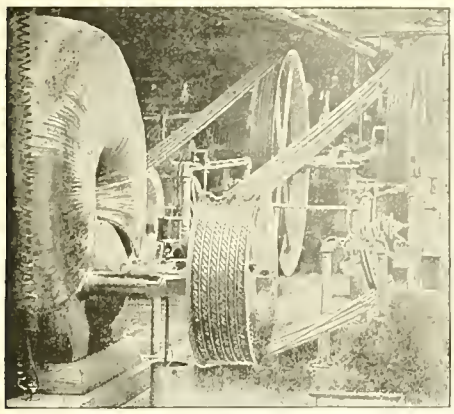

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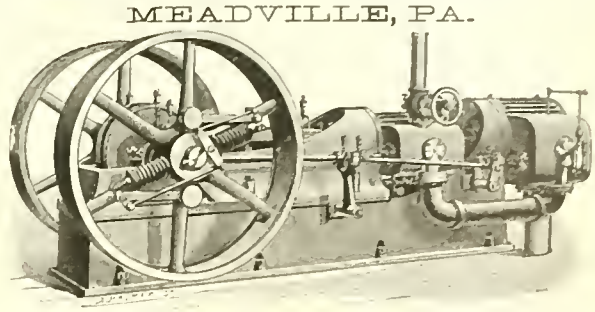

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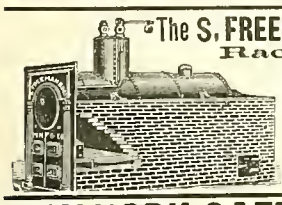

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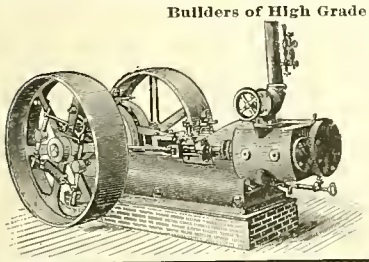

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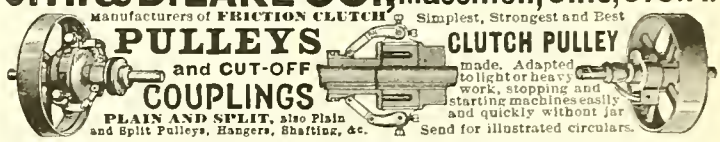

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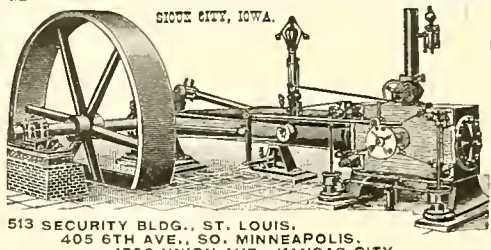

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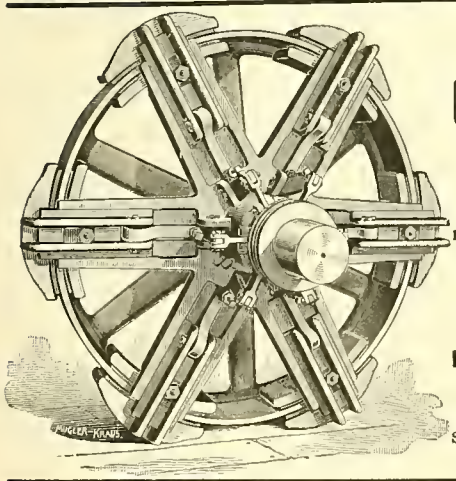

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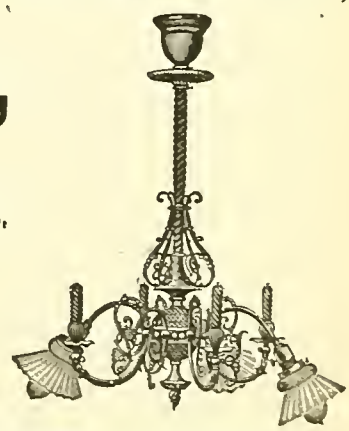

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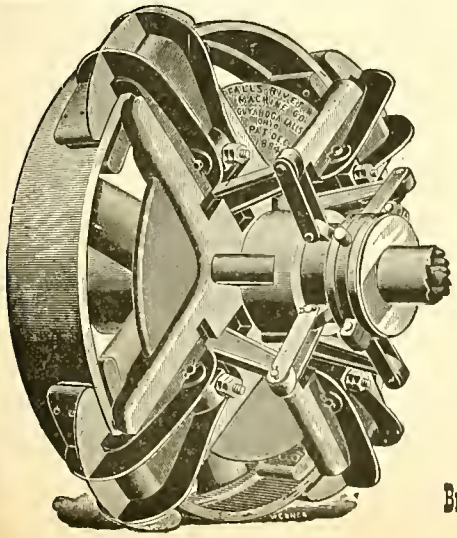

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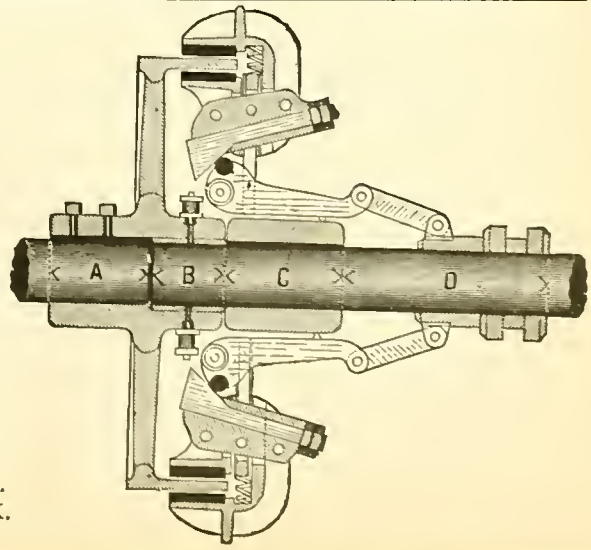

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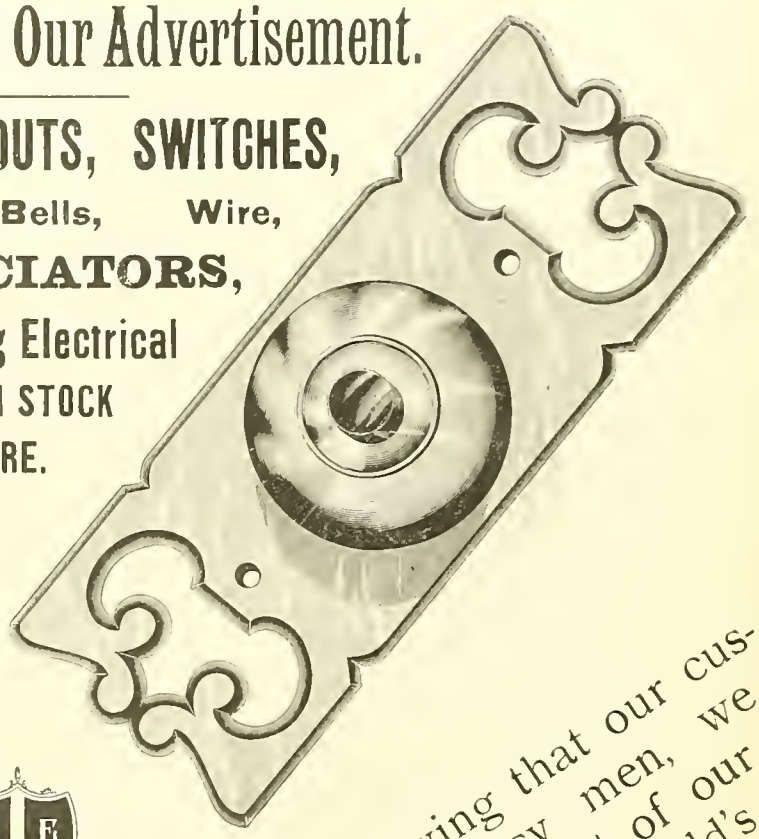

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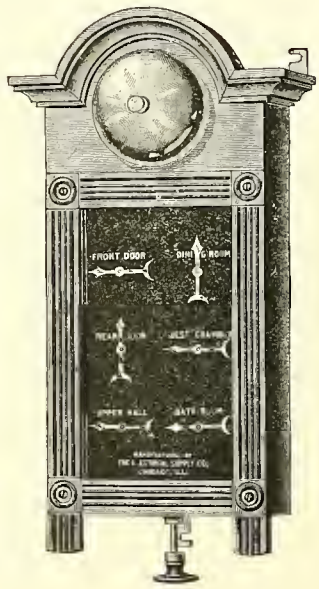

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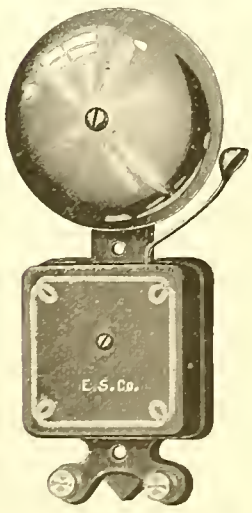

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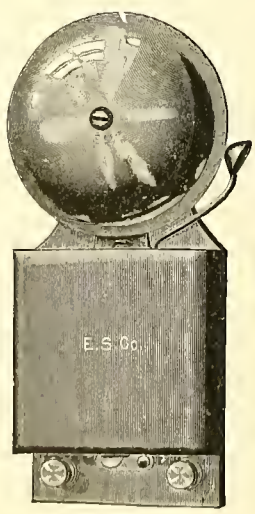

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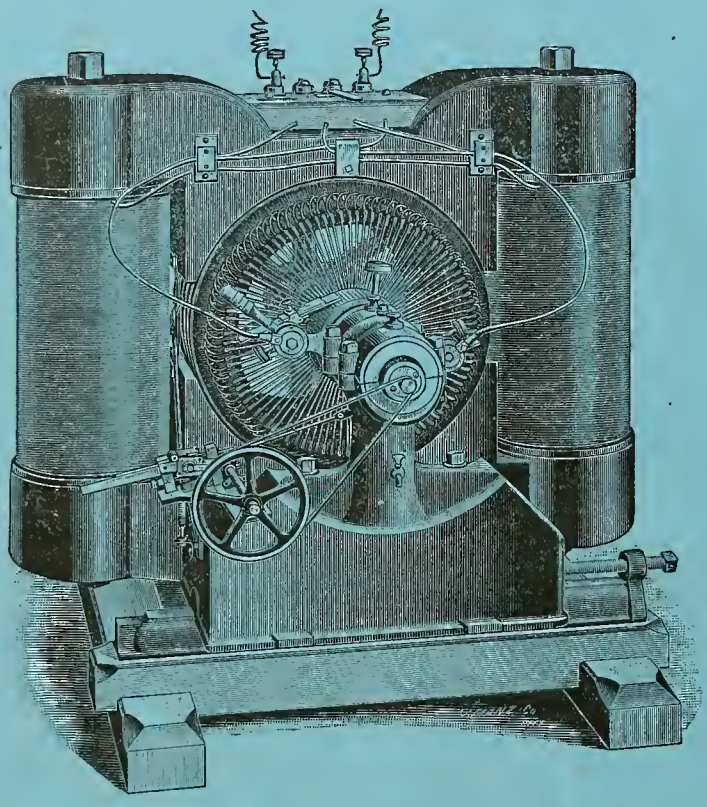

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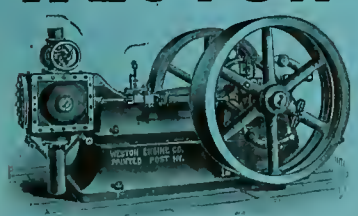

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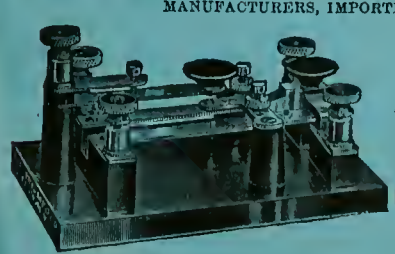

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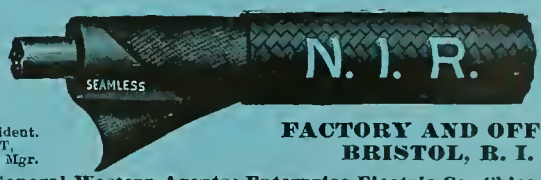

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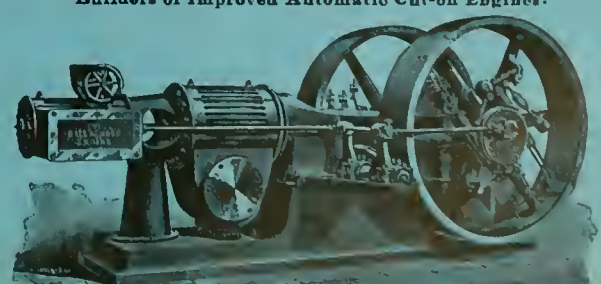

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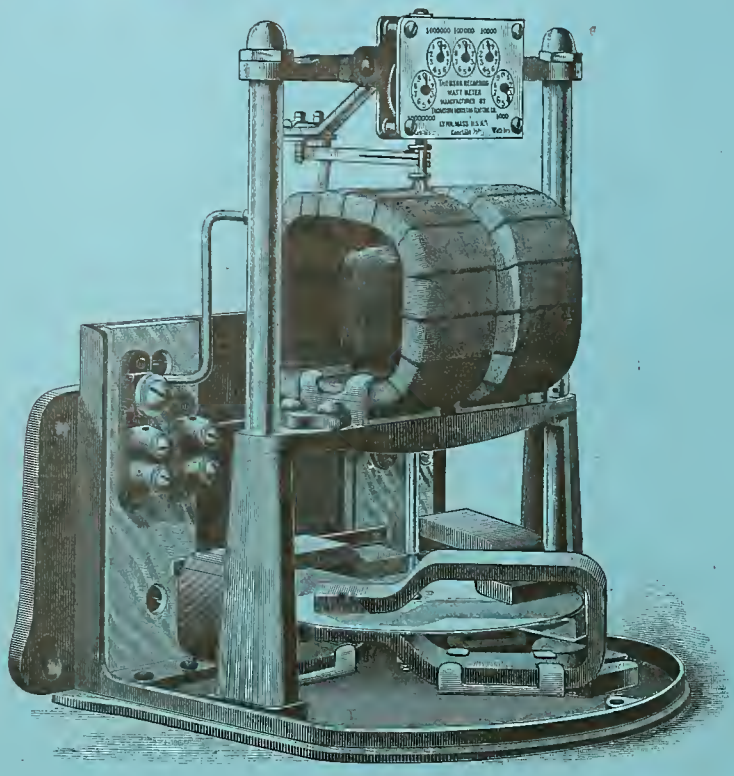

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Cabell, L. Breckinridge.
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Eddy Electric Mfg. Co.
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Siemens & Halske Electric Co.
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Waddell-Entz Company.
Westinghouse Elec & Mfg. Co.
Westinghouse, Church, Kerr & Co.
Western Electric Co.
Weston Engine Co.
Wilson & Jackson,

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Comstock, Louis K.
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Great Western Mfg. Co.
Hart & Hegeman Mfg. Co.
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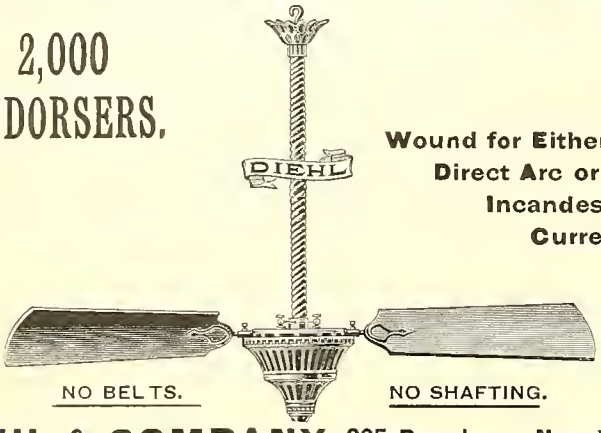

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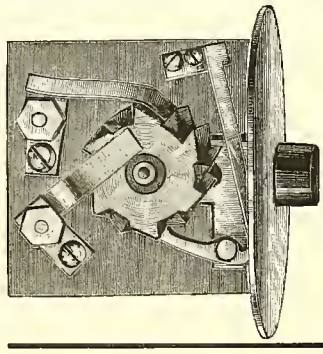

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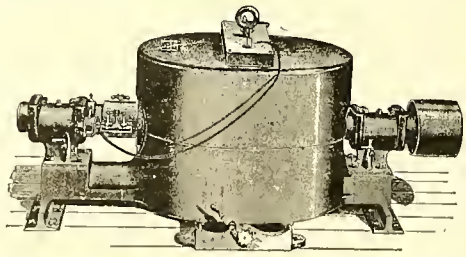

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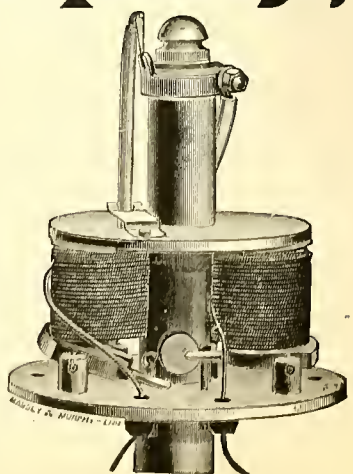

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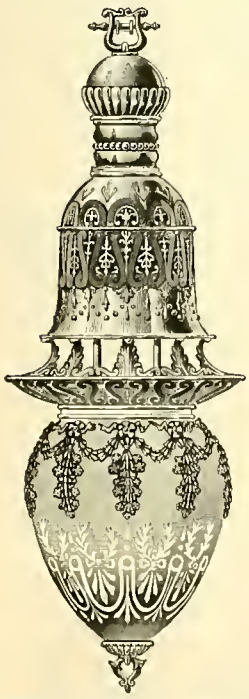

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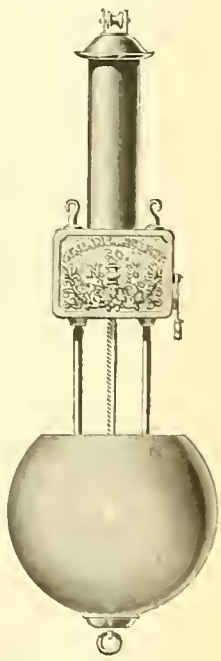

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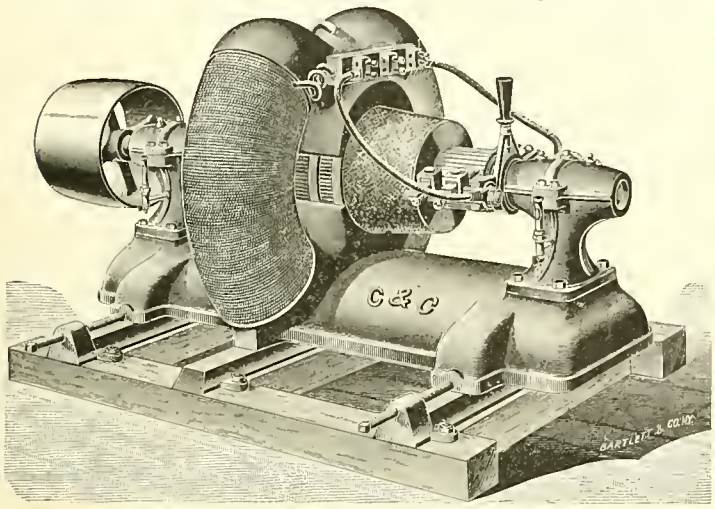

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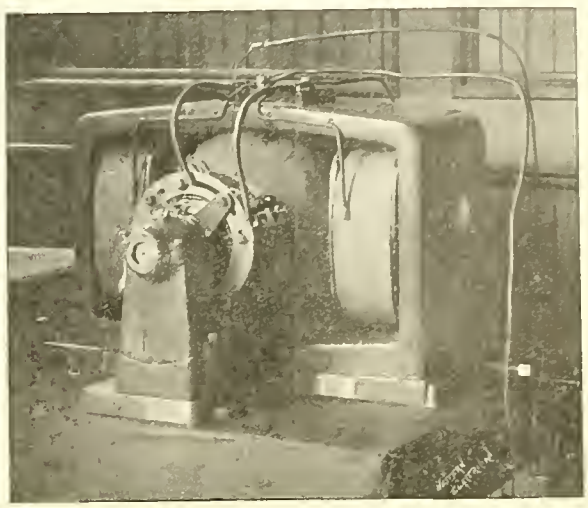

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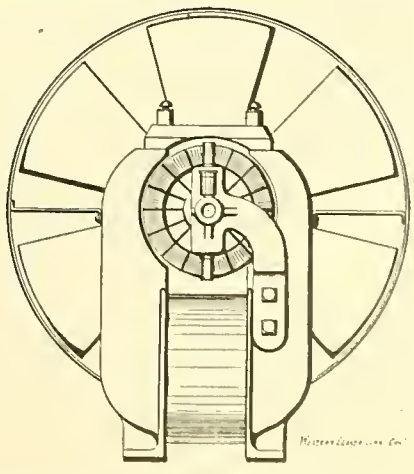

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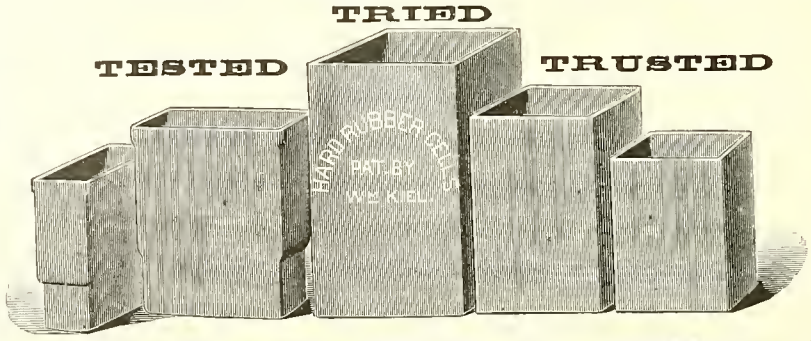

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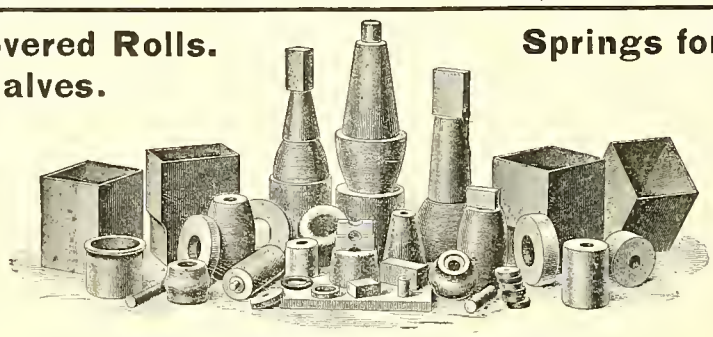

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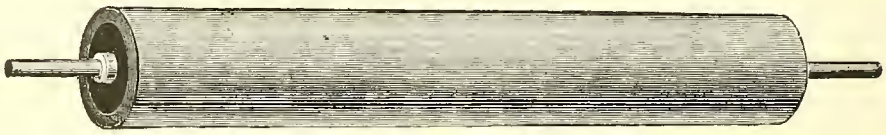

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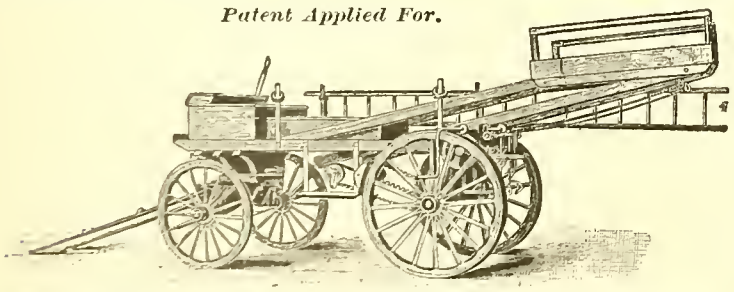

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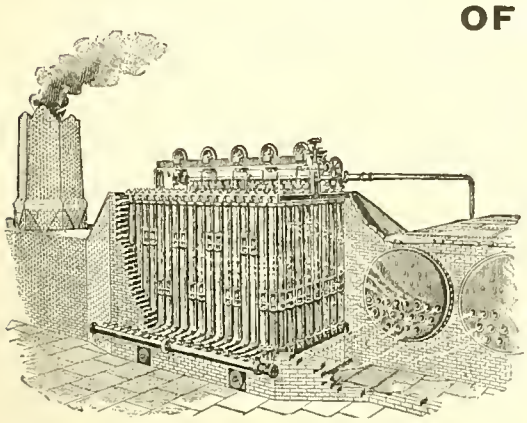

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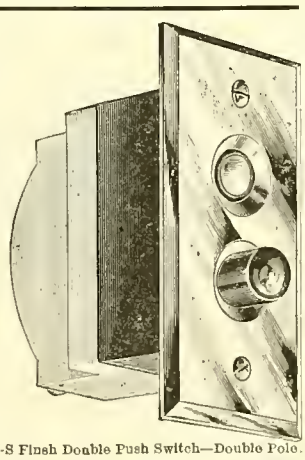

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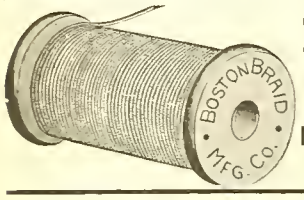

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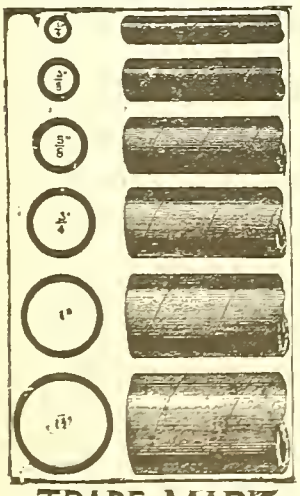

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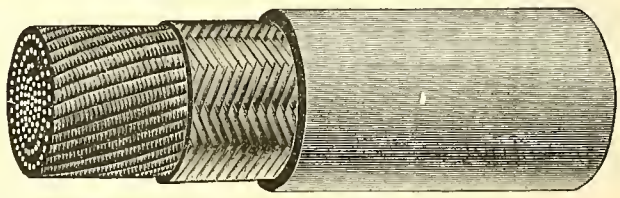

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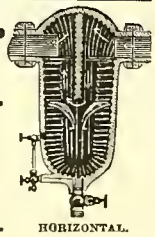

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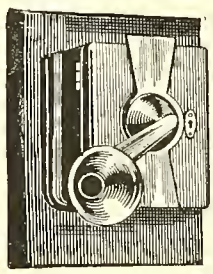

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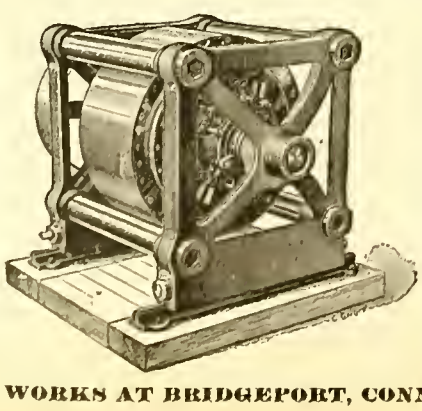

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Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, APRIL 15, 1893. No. 15

Electricity at the World's Fair.

In the strife between the General Electric and Westinghouse companies as to which should show the greatest dynamo at the World's Fair, the former seems to have come out ahead, although it must be taken into consideration that the machines chosen for comparison consist of a railway generator on the part of the General Electric company and any one of twelve incandescent alternating current dynamos installed for service lighting by the Westinghouse company. It should also be stated that the General Electric company will exhibit as well a mammoth incandescent machine of the Edison multipolar type directly connected to a vertical triple expansion engine. This combination and each of the Westinghouse alternators will have a capacity of about 10,000 lamps, but it is claimed for both that they could develop a much greater capacity if worked at the steam pressure for which they were designed, which is higher than that adopted by the exposition authorities.

However this may be, there is no question that the 1,500 kilowatt generator now building in the power station of the intramural railway (WESTERN ELECTRICIAN, March 25th) is the largest dynamo-electric machine on the World's Fair grounds and consequently the largest so far constructed in the United States. The illustration presented on this page shows the shaft that will carry the armature and fly-wheel blocked up ready for lowering into the pillar blocks. The armature core had already been bolted to the shaft when the photograph was taken, and the building up of the armature will proceed rapidly under the direction of John Riddell, master mechanic of the Lynn works of the General Electric company, who came to Chicago for the purpose. Some idea of the size of the machine, even in its unfinished state, can be gained by comparison with the figure of a man standing on the floor. But of course when the segments of the fly-wheel are bolted on the shaft, the armature wound and surrounded by a ring of field magnets and the commutator is in position the effect will be much more imposing.

The dimensions and weights of the various parts of engine and generator seem extraordinary. The engine is of the cross compound type, rated at 2,000 horse power and was manufactured by the E. P. Allis company of Milwaukee. As the armature and fly-wheel are hung close together on the shaft, which is only supported at the ends, great strength was required, and the shaft is therefore of solid steel, two feet thick and weighing 56 tons. It is 23 feet long. The entire weight of the shaft and moving parts upon it will be 190 tons. The bearings are 22 inches in diameter and 42 inches long. The fly-wheel is cast in ten segments and weighs 85 tons. It is 24 feet in diameter, with a 24 inch face. The armature will be surrounded by 12 poles, and the generator will be 15 feet in diameter. In building the armature 24 tons of sheet iron and three tons of copper will be used. The commutator alone is seven feet in diameter and weighs four tons. Upon it will bear 12 clusters of carbon brushes, with about 10 brushes in each cluster. It is interesting to note that the crank-pins by which the piston rods are attached to the crank-disks are each 10½ inches in diameter and 10 inches long. The high-pressure cylinder is 32 inches in diameter and the low-pressure cylinder 62 inches. Both are five feet stroke. The former weighs 12 tons and the latter 18. The cross-heads weigh three tons each. The entire weight of engine and dynamo is 296 tons. The armature will revolve at 75 revolutions.

In Fig. 2 is shown a representation of the big engine and generator—or rather of the parts that were in position

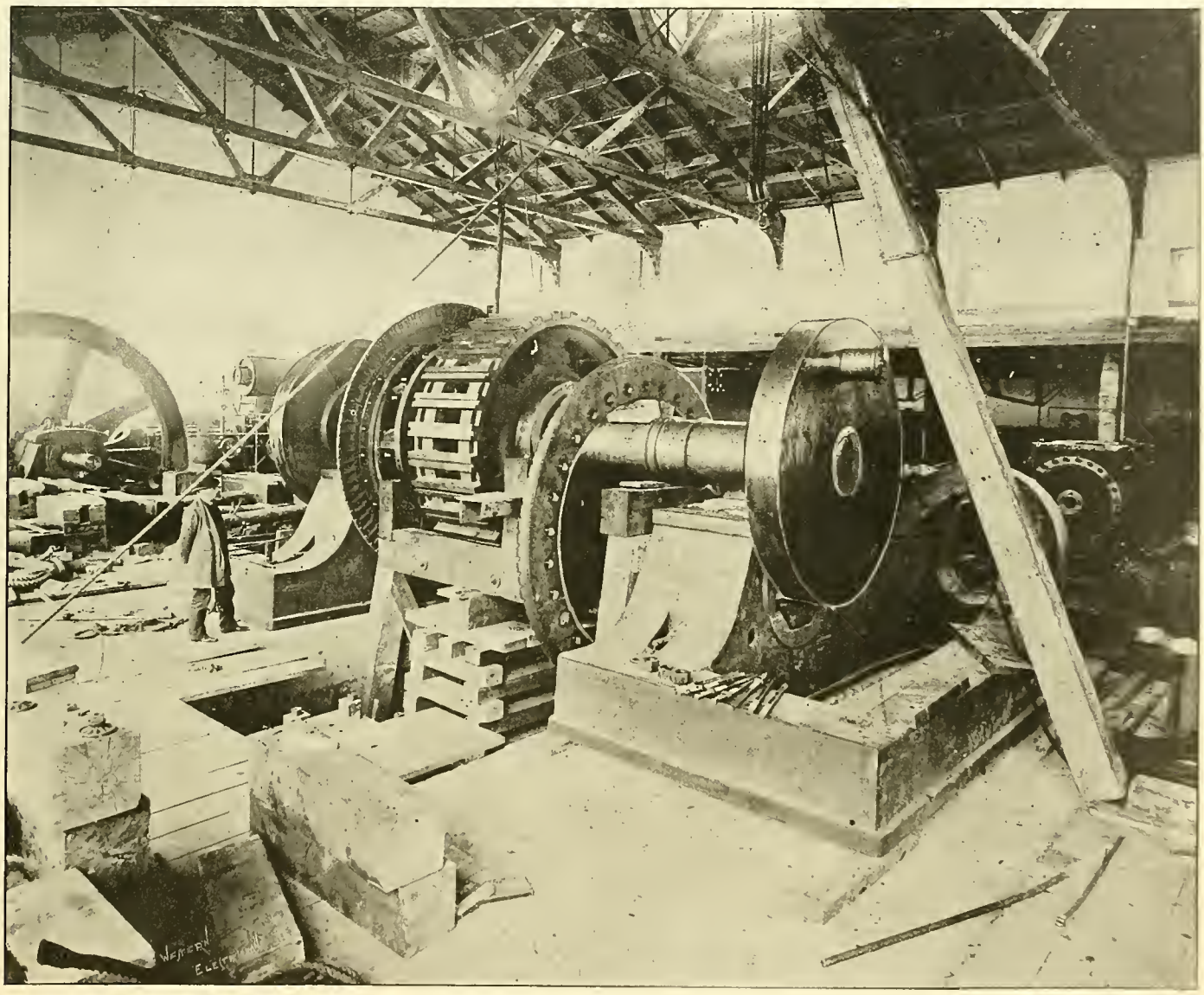


FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.

when the photograph was taken—from another point of view. To the right a portion of the Allis tandem 750 horse power engine is also shown. The engine and generator which are relied upon to furnish power for the first train moved over the tracks are shown in Fig. 3—a 750 horse power tandem cross compound condensing Greene engine, which is only awaiting the belt to drive the 500 kilowatt multipolor generator shown with it in the picture. By the time that this issue of the WESTERN ELECTRICIAN reaches its readers it is probable that a train will be making the circuit of the route supplied with current from this outfit. The man who has had charge of the installation of this heavy machinery from the foundations up is H. B. Quick, the superintendent of construction, who has discharged his duties in a highly creditable manner. Mr. Quick was formerly with Fairbanks, Morse & Co., in charge of their railroad work, and prior to this he was superintendent of construction of the Chicago, Milwaukee & St. Paul Railway company. When his present work is completed he will have handled economically about 1,000 tons of machinery without the aid of traveling cranes, derricks or overhead attachments to the building, as its temporary construction would not permit supporting much weight from the trusses.

A pretty effect will be obtained by the illumination of the golden statue of Diana at night. This figure, it will be remembered, was removed from the Madison Square Garden in New York, and now challenges the admiration of beholders on the dome of the agricultural building. Below the statue is a sunken space—the corona of the dome—and in this circle, hidden from view, is arranged a number of incandescent lights, which will reveal the fair huntress as in the eye of a calcium reflector. The absence of other lights near, together with the height, will produce the effect of a gold goddess swinging in mid-air, disdaining all support of earth. The darker the night the more beautiful will Diana appear.

Conspicuous in the Western Electric company's exhibit in the electricity building will be a miniature threater, in which elaborate stage lighting effects will be shown.

The Birmingham, England, city council has granted the loan to J. E. Hartley & Son, of that city, for exhibition at the World's Fair, the Woolwich magneto-electric machine, belonging to its collection of early historical machines. This

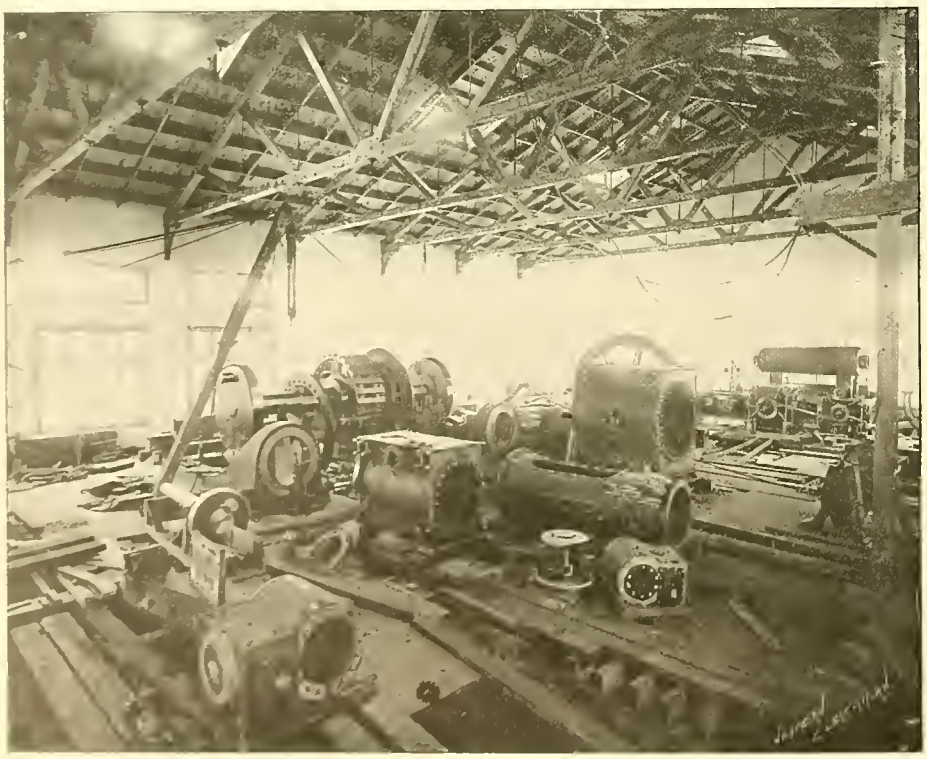


FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.

machine is said to be the forerunner of all dynamos now used, and it cannot fail to excite interest in the United States.

The Chicago Electric Wire company will make its product as conspicuous as possible in its display in the southeastern gallery of the electricity building. The space is roped off by flexible electrical cables gracefully festooned from posts wound about with insulated wire. The effect is pretty.

Gen. Barney, of the Electric Launch & Navigation company, has located his office temporarily in the annex to the agricultural building. Twelve launches from the Detroit Boat Works have already been received, and the work of putting in the batteries, of which a large stock is on hand, is under way. Work on the slips for the charging station is proceeding at a satisfactory rate.

Somebody, in writing for the *Chicago Times* of April 6th, became a trifle delirious with enthusiasm in a four-column article on the electrical features of the World's Fair, entitled "Sol May Hide His Head." Here are a few specimen sentences:

Promethean fire, snatched from heaven by Ben Franklin, will show itself a maid of all work.

The pathways between the buildings, the glades of the islets will be a milky way of constellated arc lights.

Daylight will be shown to be faint and inadequate as an illuminating power.

The people will greet the vital spark as a friend and a brother this summer.

The power that belongs to the home, that is written on the books as credit and debit, that has descended from the sky to carry on mundane business, that marches with the army, and affords the motive power to the workshop—such will be the scope of the electrical exhibit.

The heroine of the twentieth century will carry her incandescent star for the beautifying of the shimmer of the glimmer of her golden hair.

Show-case business men will be provided with $100 suits in order that they may sit at a desk all day to demonstrate the preservation of their eyesight by the use of incandescent light.

The last sweet thing in generating machines only will be used at the World's Fair, and it promises to produce a light like the spring of legend, ætherially mild.

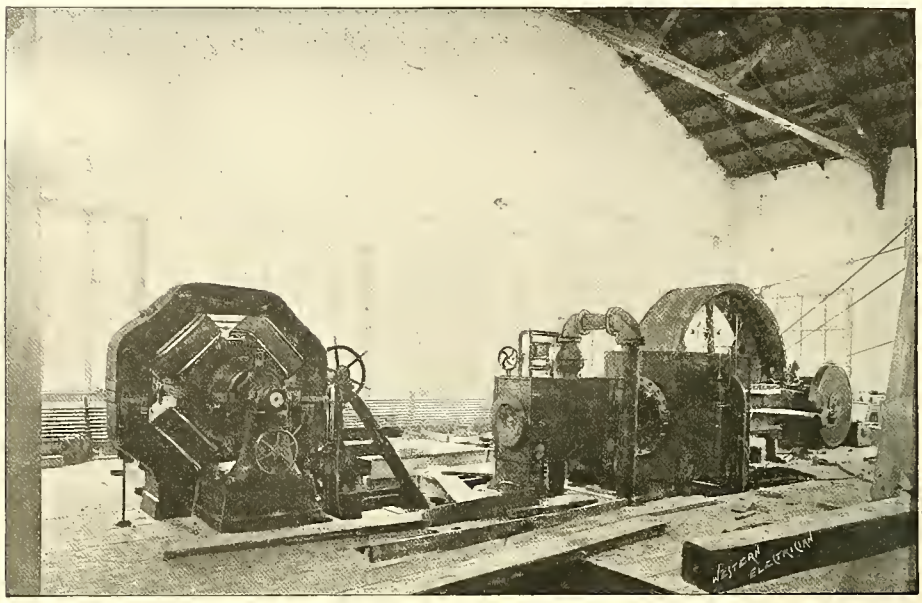


FIG. 3. ELECTRICITY AT THE WORLD'S FAIR.

Among Chief Barrett's pet ideas is a tireless opposition to the wire that disfigures the ambrosial air of heaven.

Like faith, electricity can move mountains, and when it comes to pace in moving electricity has all the best of the game.

All the machinery of the mine will look to electricity as its first cause.

Uncle Si will learn for the first time how sparks fly across the sea without producing boiling water.

Flirtations between Bar Harbor and Chicago will be at a premium.

From its birth until to-day the developments of the engine that affords the fair but tantalizing hello girl bread and butter will be traced step by step.

Edison, the wizard, has his new miracle to present. This year there will break from his workshop a living, breathing photograph, a senseless, inert object galvanized into vitality by the wonder worker's touch. It is called the kinetograph.

Not less marvelous than the exhibit of the telephone will be the demonstration of the powers of the microphone. The melancholy, monotonous ripple as it laps against the beach will awaken by its sound memories of the far away coast.

These gorgeous delineations may well excite the startling query, Can it be possible that the talented word-artist of the *Electrical World* has broken loose from New York and is even now in Chicago?

Reunion by Means of the Long Distance Telephone.

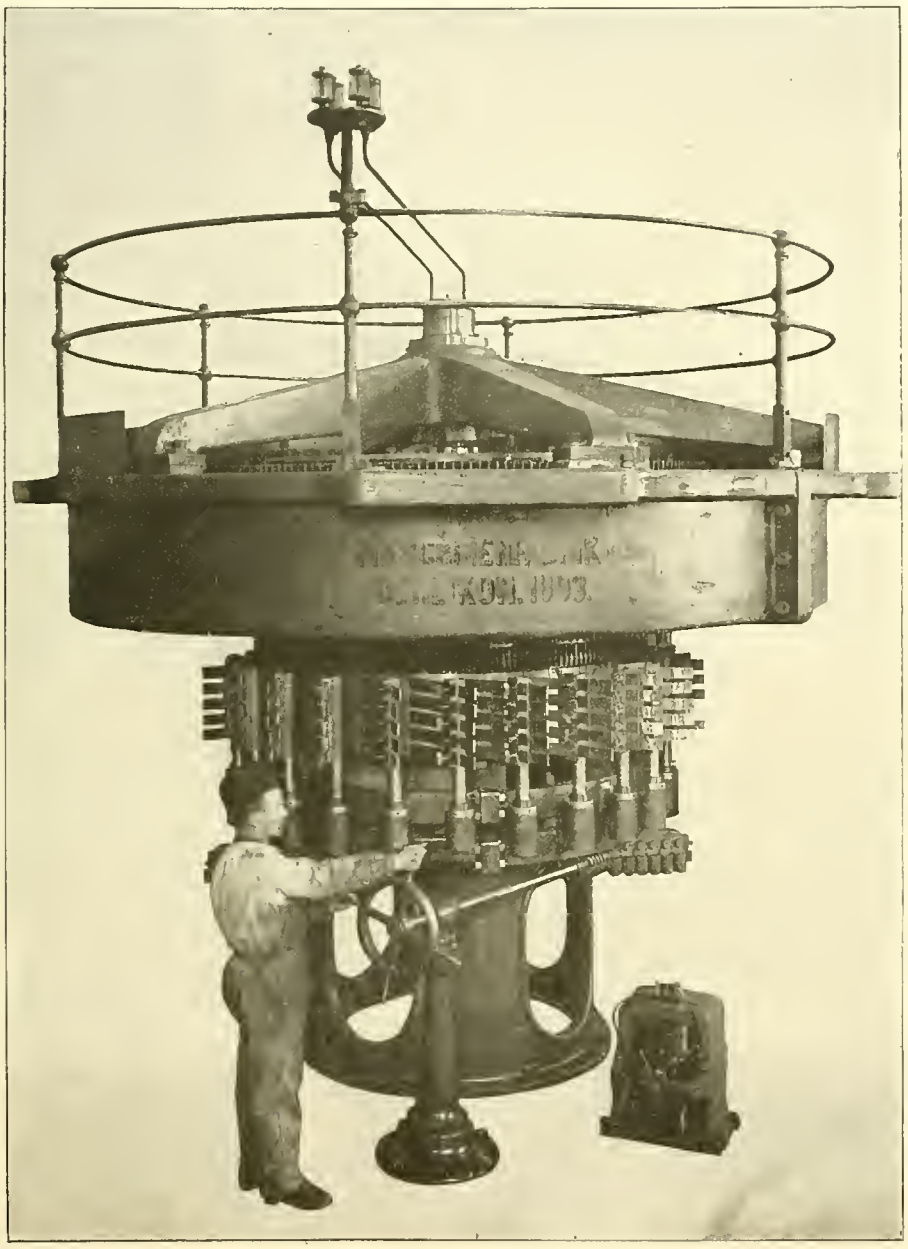
Last week members of the class of '85 of the Massachusetts Institute of Technology held reunions in Boston and Chicago upon the same night. The unique feature of the affair was the direct communication between the two parties by means of the long-distance telephone, which was placed at the disposal of the class for the entire evening. Old friendships were renewed over the wire, and class and college yells were interchanged with as much pleasure as if the two parties had been one. One Chicago gentleman furnished a zither solo and at its conclusion enjoyed a liberal burst of applause from his audience in Boston. There were thirty-nine members of the class and friends at the Boston end of the line, and the following named gentlemen were present at the Chicago gathering: James C. T. Baldwin of the Long Distance Telephone company; Reddington Fisk, assistant superintendent of the Chicago Telephone company; R. H. Pierce, electrical engineer at the World's Fair; Robert Richardson, Ansonia Electric company; F. H. Wakefield, department of information, MacKaye Spectatorium; D. E. Goe, Ansonia Electric company; Frank Pickernell, Long Distance Telephone company; Mr. Allen, Worcester College of Technology, Long Distance Telephone company; L. A. Ferguson, electrical engineer, Chicago Edison company.

Sturgis, Mich., is negotiating for an electric light plant.

Vertical Dynamo for Electro-metallurgical Work.

Among the most interesting electrical installations in Europe is that of the Aluminum Industrie Actien Gesellschaft, of Neuhausen, Switzerland, which utilizes the water power of the celebrated falls of the Rhine. At the present time four dynamos of 150 horse power each, one of 300 horse power and two of 600 horse power each are in operation. Additions to this plant are now being completed. They comprise four new generators, designed to give 7,500 amperes at 55 volts, making 150 revolutions per minute. There will be six dynamos of 600 horse power and one of 300 horse power in one room, representing an aggregate capacity of 3,900 horse power.

One of the new machines is shown in the accompanying cut, which is a reproduction of a photograph taken in the assembling room of the Maschinenfabrik Oerlikon, near Zurich. This dynamo, of over 400 kilowatts capacity, has a vertical shaft, which is directly coupled with the turbine shaft. The star-like bracket on top of the magnet frame contains the top bearing of the dynamo shaft; the magnet has 24 radial inward pole pieces, the whole being of cast iron and supported by heavy iron structures not shown in the picture. The dynamo shaft carries the armature and the commutator, this revolving mass of iron weighing 12 tons. The 120 sets of brushes on each machine can be moved within certain limits by means of a hand-wheel. The magnetic proportions are such that there is but very little shifting of the brushes at varying loads. The machines are shunt wound and self-exciting. One may say that the dynamo occupies two stories, and the turbine may be said to occupy a third one. To give some idea of the proportions of the dynamo, a medium sized man and a small continuous current Oerlikon standard dynamo of 120 volts, 20 amperes, at 1300 revolutions, have been photographed with the large machine.



VERTICAL DYNAMO FOR ELECTRO-METALLURGICAL WORK.

The turbines to run the generators are manufactured at the works of Escher, Wyse & Co., of Zurich, Switzerland. They are provided with a device to hydraulically counterbalance the weight of the revolving parts, and to thus relieve the bottom bearing the of vertical shafts. The buildings as well as the tunnel to carry off the water are the work of Messrs. Locher & Co. of Zurich.

Gas Engines in Electric Lighting Plants.

An interesting paper on the use of gas engines in electric lighting stations was read before the British Institute of Civil Engineers recently by J. Emerson Dowson. Attention was called to the fact that gas engines aggregating 7,000 horse power were in use in electrical plants in Great Britain, and that in Germany they were also coming into quite general use in this line. Several plants were described in which gas engines were used. One of these, the central station at Dessau, belonging to the German Continental Gas company, was opened in 1886. It had two 60 horse power, one 30 horse power and one 8 horse power engines, worked with town gas, and all the dynamos were driven by belting and countershafts. In 1891 alterations were made. One 60 horse engine with its belting and countershaft was retained, and one of 120 horse power introduced, coupled direct to its dynamo. The speed of the engine and coupled dynamo was 145 revolutions per minute, and the consumption of gas was equal to 39 cubic feet per kilowatt hour. Since February, 1889, the municipality of Schwabing, a suburb of Munich, has used an Otto engine worked with Dowson gas for 10 arc and 300 incandescent lamps. The load was variable, but, with an average output of 22.5 kilowatts per hour, the fuel consumption was 3.3 pounds per kilowatt hour. The town of Morecambe was lighted by nine arc lights and incandescent lamps, equal to 1,600 of 8 candle power each, the dynamos being driven by Stockport gas engines worked with Dowson gas. With an output of only 1,155 kilowatts per week the consumption of fuel was 2 56 pounds, and the cost of the gas, including wages and fuel, was ½d per kilowatt hour delivered. At the chateau of M. Say, at Longpont, in the South of France, there were 650 incandescent lamps and one arc light supplied by a dynamo driven by a Crossley engine worked with Dowson gas. The consumption of fuel was 1.2 pounds per indicated horse power hour and 2.7 pounds per kilowatt hour. It was believed that the late Sir William Siemens first drew attention to the fact that, when illuminating gas was burned in a gas engine to drive a dynamo, much more light was produced electrically than could be produced by burning the same quantity of gas in burners in the usual way. Latterly the consumption of gas per horse power hour in gas engines had been reduced, and the ratio was at the present time about 20 to 1 in favor of converting the gas into an arc light by means of a gas engine. The author had collected data from various sources as to the consumption of ordinary town gas by engines supplying electric light, with and without accumulators. The average of all the returns, with engines under varying loads and without accumulators, was about 47 cubic feet per kilowatt hour; when accumulators were used the consumption of gas was less, because the engines then worked under a full load. With 47 cubic feet per kilowatt hour, and 55 watts per 16 candle power, one light of that power required only 2 6 cubic feet per hour, whereas a standard argand burner required 5 cubic feet per hour. In this comparison it was assumed that the incandescent lamps and gas burners were in good order; but under ordinary working conditions they did not maintain so high a duty.

The question of load-factor was a serious one with any type of engine, but with gas engines the loss was much less than with steam engines. When a gas engine was stopped, its consumption of fuel stopped also, and there was no furnace to maintain; nor was there any water to boil at starting. At the same time, it was desirable that the gas engine should be worked as much as possible under a full load, and in this respect the experience at Dessau was generally confirmed. A central station was worked under trying conditions, and in the London district there was only a full output of current during from three to five hours in every twenty-four; moreover, about 60 per cent. of the total output was required during that short period. In practice, this meant that in a station where the current was supplied without accumulators the engines were run at a reduced speed during a portion of the time, and at other times some of them were stopped altogether; but all had to be ready to work in the evening, and occasionally in the daytime when there was fog. Generally, it might be assumed that the average consumption was more than 6 pounds per kilowatt hour where accumulators were used, and about 9 pounds to 12 pounds where they were not used. In any case, with the best possible arrangement of steam power, there must be a large amount of fuel consumed which did no useful work; for, even if some of the fires were drawn, they had to be relighted, and the large quantity of water which had cooled during the time of standing must be reheated.

With a large gas engine 1 British horse power per hour could be obtained with a consumption of 1 pound of anthracite, or 1½ pounds of coke; whereas the consumption of coal with the steam engines used for central stations must be taken at about 2 1-2 pounds per British horse power, when working under a full load. A saving of not less than 50 per cent. could therefore be effected in stations where the engines were fully loaded; and, where there were great fluctuations in the output, the loss of fuel with boilers not used, or only partly used, could be almost entirely avoided. For a maximum output of 400 kilowatts there would be three gas generators, each capable of supplying one-third of the maximum required. The production of gas could be raised or lowered in several ways, and the working of each generator could be stopped immediately by shutting off its steam supply. Supposing, therefore, that all three generators were working at their maximum rate, and a gradual reduction was required, this could easily be effected; and, when the production of one or two generators could be dispensed with, their operation was at once stopped. The third generator could then be kept at work, and its production adjusted to suit the minimum consumption required. A gas generator had a small grate area compared with that of a boiler, and much less cooling surface: it contained no water, and required no chimney draught. A generator of the size referred to lost only 6 to 8 pounds per hour while standing. If an average of only 40 per cent. of the maximum power were required for 21 hours, it was equivalent to letting two of the generators stand for that period; and at 8 pounds each per hour that meant a total loss of only 300 pounds, compared with the much greater waste when steam power was used.

When town gas was used for driving the engines of an electrical station, the consumption was about 50 per cent. less than the volume of gas required to give the same amount of light by ordinary burners. When town gas was used, neither boiler nor fireman was required, and there were no ashes to remove; less space was needed; no accumulators were required, except such as might be necessary to equalize the load of the engines, and to provide for a small amount of storage. The engines could be worked in the most crowded districts, close to where the lights were required, and where boilers were not allowed. When generator gas was used, the consumption of fuel under a full load would be at least 50 per cent. less than with steam power, and the loss due to steam boilers not being fully worked could be almost wholly avoided.

David E. Evans of Baltimore has completed the plans and specifications for the electric lighting plant of Petersburg, Va. Work on the plant will be begun at once.

Moissan's New Electric Furnace.

At a recent session of the Academy of Sciences, Paris, Henri Moissan and Jules Violle presented a communication describing two new forms of electric furnace which they had designed. It will be remembered that Moissan's experiments with high temperatures produced by means of the electric arc so interested the French government that Moissan was authorized to continue his experiments in the laboratory of one of the public scientific institutions, and Jules Violle, professor of physics in Ecole des Arts et Metier, was designated as his collaborator.

The old type of Moissan's furnace consisted of little more than two refractory bricks, so hollowed out that a cavity

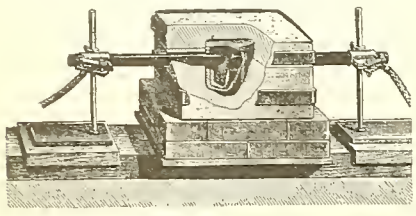


FIG. 1. MOISSAN'S NEW ELECTRIC FURNACE.

was formed for the reception of a crucible. This simple type was illustrated in the WESTERN ELECTRICIAN of March 25th in connection with an article descriptive of Moissan's attempts at diamond making. The new form of furnace is composed of a cylinder of carbon, the height and diameter of which are the same, within which an electric arc play, between two horizontal electrodes. The cylinder is made of a bit of carbon tubing, and it rests on a plate of the same material. The cover is a carbon disk, the diameter of which is the same as that of the cylinder. Two openings are left for the electrodes. The cylinder is placed within a block of calcareous stone, similar to that used by Deville and Debray when fusing platinum. The cylinder does not touch the calcareous wall, but is separated from it by an air space of 5 millimeters, the base resting on strips of magnesia.

The size of the furnace depends upon the degree of capacity that it is desired to employ. For currents ranging between 300 and 500 amperes the cylinder is formed of a carbon tube 6.5 centimeters in diameter. The carbon electrodes are from 3 to 3.5 centimeters in diameter; the block of refractory stone is about 20 centimeters in height, 2.5 centimeters in width and 30 centimeters in length. The covering disk is from 4 to 5 centimeters in thickness. The carbons are held by clamps which may be slid along on the base as may be desired in order to adjust the distance of the arc.

The cuts illustrate the two new forms of furnace designed by Moissan and Violle. Fig. 1 is the type which is found to be suitable for the fusion of refractory metals, such as chromium and manganese. This furnace contains at the bottom of the cylinder a carbon crucible, which holds the mixture to be reduced.

Fig. 2 shows the form used for calorific investigation by which the temperature of the arc is determined. The bottom of the cylinder is then closed by a carbon plate which slides into place like a drawer. At the positive pole is

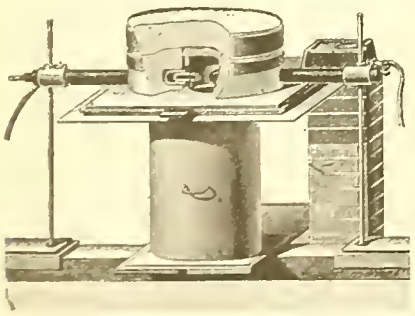


FIG. 2. MOISSAN'S NEW ELECTRIC FURNACE.

placed a bit of carbon, held by a rod of the same material, sliding with little friction into the cylinder. One has simply to draw out the rod at the proper time to cause the carbon, transformed into graphite, which had reached the desired temperature, to fall into the calorimeter.

The temperatures obtained naturally vary in accordance with the duration of the experiment and the size of the furnace. The more the calorific field is contracted the nearer the point is reached indicated by M. Violle as the highest temperature that can be produced by the arc. Practically the investigators have found no difficulty with their apparatus in reaching temperature greater than 3,000 degrees. The cuts are reproduced from *L'Industrie Electrique*.

An Electric Deck Planer.

Malcolm Sutherland, the electrical engineer of the shipbuilding firm of Wm. Denny & Bros., Dumbarton, Scotland, has made a new application of electrically transmitted power, as shown by the accompanying illustration of an electric deck planer which he has invented. The machine is used for planing the decks of ships, and is very simple in construction. The tool resembles a lawn mower in form and is handled in the same way, and with as much ease. A steel base plate is mounted on rollers, and on the under side of this the revolving cutter is fixed. The electric motor is geared to the cutter by means of toothed wheels. One of Rawlin's spiral cutters is used, and revolves at a speed of 3,000 revolutions per minute, the motor having a speed of 2,000 per minute. The rollers which follow are fitted with eccentric journals, so that by moving a lever they can be raised or lowered and the depth of cut nicely adjusted. The machine does good work, is faster than hand planing, and relieves the men of a disagreeable job, as the planing of decks by hand involves kneeling or sitting in a very uncomfortable position. Current is supplied to the motor by means of a twin flexible cable, and the whole machine is of a compact and portable nature. The cut is reproduced from the *Electrical Review* of London.

A Hysteresis Theory of Brown's Alternating Current Motor.[1]

By J. A. KINGDON.

The single-phase motor of C. E. L. Brown, which is the latest attempt to solve the alternating current motor problem, has been fully described[2] and has no doubt attracted a considerable amount of attention on account of its undoubted novelty and its extreme simplicity. No attempt has been made to explain, or even to indicate, the nature of the actions which produce the motion, but as a clear idea of what takes place in the motor may lead to further developments, it is proposed to investigate the matter in a common-sense fashion, and without recourse to the abstruse mathematical expressions which are so prominent a feature of our *fin de siecle* electricity.

It is usual to commence an attack on alternating current problems of this nature, with the statement that "secondary currents are in quadrature with the inducing primary currents." The meaning of this expression is that the induced secondary currents are zero when the primary currents have their maximum values, and are at their maximum values when the primary currents are zero. As the reaction between currents in quadrature is nil, so that no attraction or repulsion could be set up by them, it is then usual to call in the assistance of self-induction, which produces according to this theory a lag of the secondary current and sets up a repulsive action between the primary and secondary currents.

Now, in the first place, secondary currents are not in quadrature with the inducing primary currents. Setting aside the initial magnetizing current, the behavior of which has already received consideration in these pages, secondary currents are very nearly co-phasal with, but opposite in direction to, primary currents. That is to say, primary and secondary currents attain the maximum values and zero values at almost identical moments of time. The truth of this statement has been proved experimentally, but it may be pointed out that the mere fact of the "parallel regulation of transformers" proves it conclusively without further experimenting. The reasoning is as follows:

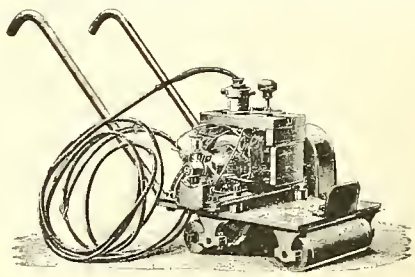
If the primary of a transformer be connected with a supply of alternating current at a fixed pressure, the pressure at the secondary terminals (allowing for a slight drop at full load) will remain constant for all values of the secondary current from zero to full load. It follows from this that the maximum induction reached in the iron of the core is constant for all loads. But as the secondary current increases from zero to its maximum value, the primary current increases from the initial value of the magnetizing current of the transformer on open circuit to 50 or 60 times (in a good transformer) this value at full load. If the secondary current were in quadrature to the primary current—that is, if its value were zero when the primary is at a maximum, the magnetic induction of the core would increase very considerably and the pressures would rise. As a matter of fact, the constancy of pressure shows that the magnetizing effect of the induced secondary current is equal and opposite, putting out of the question the initial magnetizing current, to the magnetizing effect of the primary current. The secondary current is, therefore, identical in phase and opposite in direction to the primary current.

Next, as to self-induction. Self-induction is like charity. "Charity covereth a multitude of sins." Self-induction explaineth the multitude of obscure phenomena.

As the writer mistrusts this constant use of self-induction in a vague and inaccurate sense, he will proceed to the investigation of the Brown motor without further reference to it.

The first point that strikes the eye in the diagrams of the various types of motor is that, with one exception, the air-gap between the fixed and moving iron is absolutely uniform, although in the inducing part there are well defined though constantly changing magnet poles and not a pair of rotating poles, as in the two-phase Tesla-Ferraris motors. If the motor is at rest no movement is set up when the current is switched on, although considerable secondary currents are induced in the windings. If we suppose that a north and south pole are momentarily set up at N and S in the primary magnet of Fig. 1, it follows that the secondary currents tend to magnetize the secondary magnets n and s with magnetism tending to counteract the magnetism of the primary current; but the latter, having the dominant magnetism, masks that of the secondary current. This is an instantaneous condition of the apparatus when at rest.

If, however, by some device, mechanical or electrical, the motor is once started, the effect of hysteresis comes into play, and different conditions result. The effect of hysteresis or magnetic viscosity is as follows:—A piece of soft iron magnetized by a current retains a good deal of its magnetism even if the magnetizing current falls to zero. If instead of reducing the current the magnetic resistance is increased, for example by increasing the air-gap, the same



AN ELECTRIC DECK PLANER.

effect takes place. In the Brown motor the air-gap being uniform, the effects of hysteresis will be particularly marked, the result being that if the interior magnet is moved in the direction of the arrow in Fig. 2, the hysteresis of the iron distorts the magnetic field in the manner indicated in the figure.

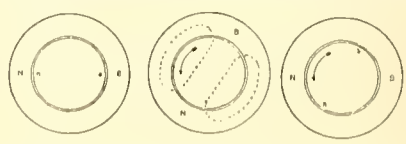
Now, the phase of the secondary currents is identical with that of the primary current, but their direction depends upon the position of the resultant magnetic field as distorted by the motion of the inner magnet owing to the hysteresis of the iron.

The result is, that the polarity set up by the secondary currents is no longer in the line $N\,S$ of the poles of the primary magnet, but is distorted through an angle, as shown at n and s in Fig. 3.

It will be noticed that the secondary poles in Fig. 1 are of such a sign as to be repelled by the primary poles, but, being in a symmetrical position in relation to them, there is no rotation in either direction, although the rotating part of the motor is in unstable equilibrium. As soon as the polar symmetry of the arrangement is destroyed by the rotating part of the motor receiving motion in one direction or the other, the repulsion between the primary currents and the secondary currents is no longer balanced, but has a resultant in the direction of the arrow in Fig. 3, which is in the same direction as the motion in Fig. 2. It must, however, be remembered that, even if the rotating part of the motor is in motion, the secondary poles would still remain opposite the poles of the primary current, were it not for the effect of hysteresis in distorting the resultant magnetic field of the two parts of the motor. Perhaps it is advisable to point out that the primary current tends to prevent the distortion of the field by the motion of the rotating part, and no doubt does so to a great extent, as long as the value of the primary current is considerable.

The secondary currents, generated as they have been by the previous magnetic wave, and having the polarity of Fig. 3, while they tend to accelerate the motion, also tend to reduce the distortion produced by hysteresis, and, in fact, to distort the field in the opposite direction. Hence there is not much actual distortion of the magnetic field until the primary and secondary currents decrease almost to zero, which, as has already been pointed out, they do nearly simultaneously, and it is near the time of their zero values that the combined hysteresis of the iron and the rotation of the motor produce the distortion of Fig. 2. The effect is, that the next wave of secondary currents are set up with an unsymmetrical polarity, by which, as Mr. Brown points out, "a turning moment is produced."

The foregoing explanation may be termed "the hysteresis theory of alternate current repulsions," as dis-



FIGS. 1, 2 AND 3. A HYSTERESIS THEORY OF BROWN'S ALTERNATING CURRENT MOTOR.

tinguished from the "self-induction theory" already alluded to. Experiments are, no doubt, needed to ascertain the exact effect of hysteresis under the conditions of lengthening the magnetic circuit, or rotating part of the iron which composes it, as well as under the conditions of varying the exciting current, and it is hoped that the attention of those who are able to undertake such experiments may be drawn to the matter.

When the cores of the fixed and rotating parts are both smooth and without slots or recesses for the wire, there is no considerable resistance, except that of hysteresis, to the shifting round of the magnetic poles, so that, even if the speed is synchronous, there is no great tendency to keep it so. If, however, the rotating core is deeply slotted, well-defined poles would be set up in the rotating part which would tend strongly to synchronize with the alternations of the current, and every time the poles shifted past a slot the lines of force would cut the thick copper conductors, and set up strong secondary currents which would have a synchronizing action.

1. From the London *Electrician*.
2. WESTERN ELECTRICIAN, February 4, 1893.

If the foregoing explanation of Brown's motor is correct, it is likely that hysteresis, which has hitherto been regarded merely as a vexatious and wasteful phenomenon, may turn out to be a property of great value to the electrical engineer.

Model Isolated Lighting Plant.

The Meyer Building, at the southwest corner of Franklin and Van Buren streets, Chicago, is a specimen of the best practice in the construction and equipment of business blocks. The architects, Adler & Sullivan, have used all

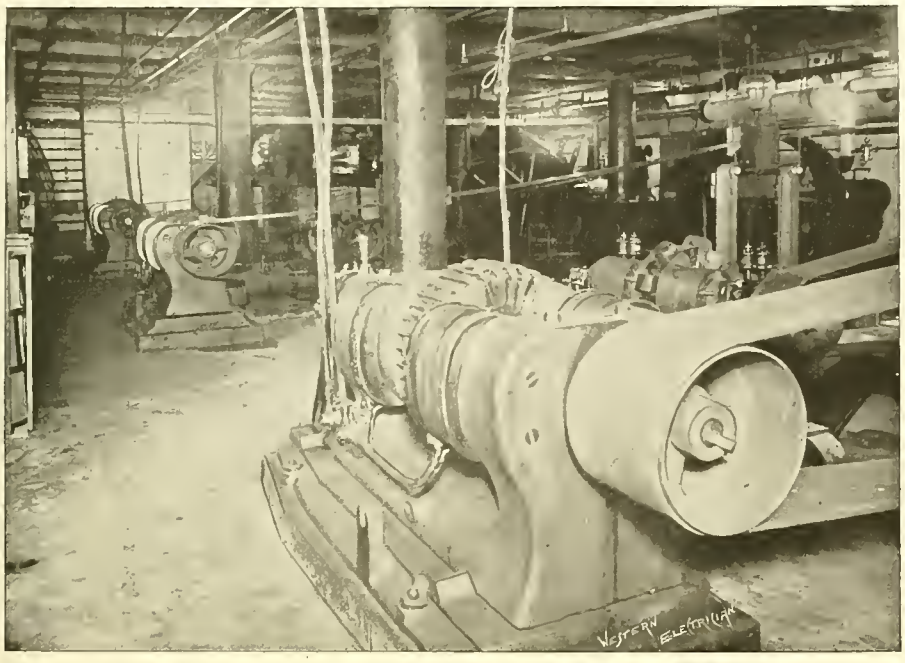


FIG. 1. MODEL ISOLATED LIGHTING PLANT.

the possibilities to secure convenient arrangements and excellent light. One unusual feature in a Chicago building is the assignment of ample space to the boilers, engines, pumps, heating and electric lighting apparatus, which, compared with the confined limits allowed in too many Chicago structures, commands admiration for the progressive spirit displayed.

The electric lighting plant which is herewith illustrated was designed by Charles G. Armstrong, and installed by the Chicago office of the Brush Electric company. There are three McEwen center crank engines, to each of which is belted, by the Page Belting company's slotted belt, one arc dynamo of 40 lights, and one incandescent dynamo of 360 amperes. There are in use 108 arc lamps of 1,200 candle power each, and 2,000 16 candle power incandescent lamps. The arc dynamos are the familiar Brush machines, while the lamps are of the new Brush–Adams style. The dynamos for incandescent lighting are shown in Fig. 1. They are of a type in which the Brush armature is wound in numerous sections with very few turns. The armature core is of thin iron ribbon; the driving of the coils is positive, and secured by a series of brass driving horns cast on a ring imbedded in the core. This is a departure from the former practice of driving by slots milled in the iron. On the 360 ampere dynamos there are but three turns per section of armature winding, the winding being three wires in multiple. On the dynamos of this type of the next larger size, it has been found practicable o reduce the winding to two turns per section and to wind with one wire, so that there is but a single layer of wireon the core. Aod the core being only partially covered, and the wires being exposed on three sides to the air, the armatures run very cool.

The field magnets are very powerful, relatively to the armature and to the watts required to excite them. This, combined with the careful shaping of the pole pieces, and adjustment of the air gap, gives a commutator that does not spark, and a neutral area so wide that great variations of load have no effect at the brushes. In fact, one cannot tell by inspection of the brushes whether a machine is in circuit pulling its share of the load or out of circuit and doing nothing.

The switchboard is shown in the background of Fig. 2. The material is slate, treated to remove natural moisture and prevent absorption. It is finished in black enamel. There are double pole switches and ampere meters for each dynamo and circuit, and a general ampere meter hrough which all the current of the incandescent system sent. The right hand panel is arranged for the three arc dynamos and three circuits; connections being made by insulated plugs to rubber brushed sockets set behind the slate, so securing entire safety to the operator. A full set of fuse holders with break plugs; a Weston voltmeter and push button combination to connect it to any center of distribution, with the usual details, complete the board.

The Saleve Mountain Electric Railway.[1]

From the Saleve can be seen one of the grandes' panoramas of the Alps and Mont Blanc, and as there is no other town of the importance of Geneva so close to a mountain so admirably situated, this view is highly appreciated by inhabitants and tourists, although those who care to climb 4,000 feet are necessarily restricted in number. The mountain railway which now makes the Saleve one of its stations therefore presents many advantages by being able, in a delightful run of two hours, to raise visitors above the fog into the pure air of the mountains.

The rack of the Saleve railway comprises two lines; the first starts from Etembrieres and goes to Haut-Mornex by gradients of not over 16 per cent. Thence the gradients become greater, reaching 20 per cent. up to the point of forking at Monnetier-Mairie. The track then rises by gradients of as much as 25 per cent. at a maximum, curving round the Grand Saleve in a long sweep. At the curves the normal minimum radius is 160 feet, but in one case it is reduced to 115 feet. The section Veyrier to Monnetier has two tunnels, 360 feet and 160 feet.

The power for working the railway is obtained from hydraulic station at Arthaz, situated on the right bank of the Arve. A fall of 20 cubic metres per second down 3 feet gives an available power about 600 horse power. There are three turbines of 250 horse power each; the first for the week-day service, the second for Sundays and fete-days in addition, and the third is spare, or for the supply of other electric power in the neighborhood. A small 25 horse power turbine drives the exciters of the dynamos.

The generating dynamos are of the Thury type, but of a special design for direct driving from the turbines without belt or gear. The turbines only running at 45 revolutions per minute, it was difficult to erect dynamos capable of supplying 250 horse power at such a slow speed; the plan adopted has been to employ dynamos of a normal output of 1,000 horse power when running at a normal speed of 180 revolutions, and run these at the lower speed. It will be seen, therefore, that very powerful machines are used, working at a quarter of their force—perhaps neither a very economical nor cheap method, but one which may be, at any rate, considered solid and secure.

Each dynamo is capable of supplying 275 amperes at 600 volts. The size is tremendous—10 feet exterior diameter, armature 7 feet 9 inches diameter, weight 19 tons. The axle of the dynamo is vertical, carried directly by the axle of the turbine. The field magnets are carried on a special frame-work. The dynamos are among the largest continuouscurrent dynamos yet constructed.

The speed of turbines and dynamos is constant, and the variation of electromotive force required in the utilization of the current is obtained by a special regulating arrangement. The exciting current for the dynamos is taken, as already mentioned, from a small 25 horse power turbine and dynamo. This turbine is furnished with regulator maintaining a constant speed; the exciting current of this dynamo is varied by the introduction of resistances in its field-magnet circuit. A special apparatus, controlled by current brought by two wires from the end of the line, enables these variations to be brought about automatically. The electromotive force of the exciter being thus varied, that of the generators will also be varied in the desired ratio, so that the cars in movement are always supplied with their full current.

The current is transmitted from the generating station to the central railway station at Monnetier-Mairie, distant about two kilometers.

The conductors are overhead, carried on large telegraph posts. They consist of two large copper cables of high conductivity, 430 millimeters section each on the posts. Beside the cables are also the two pressure-regulating wires above mentioned. From this station the current is distributed in three sections. Along the line the conductors are formed by a Vignole rail placed parallel to the railway lines on iron brackets bolted to the sleepers, carrying strong porcelain bell insulators. On this rail is placed the shoe, with an expanding joint of soldered copper. On the shoe a slider fixed to the car receives the current. The conductor, rail being the same as that of the track, can be interchanged after wearing away. The return is by the railway line. The loss in the conductors is 15 per cent.

The cars have transverse compartments; they carry 40 passengers, 24 in the three compartments, and 16 on the two platforms (continental tramways generally allow riding on the platforms). The car, complete, weighs 12 tons.

The traction is carried out by double set of motors and cogwheels gearing into a cogged rack. Safety is thus assured, as either set is capable of holding and starting a loaded car on the maximum gradient. The motors are four-pole Thury dynamos of 25 kilowatt capacity running at 600 revolutions. This speed is capable of being varied within considerable limits, the speed of progression varying from 5 feet to 0.5 feet per second. The driving switches can be worked from either platform.

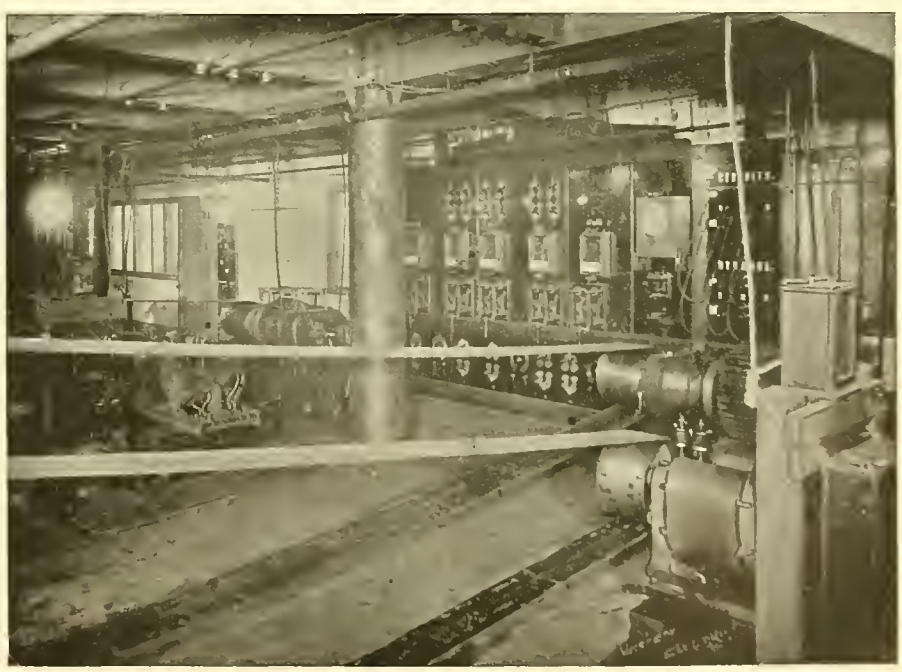


FIG. 2. MODEL ISOLATED LIGHTING PLANT.

[1] From the London *Electrical Engineer*.

Gallipolis, O., is soon to be lighted by electricity

Western Electrician.

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Gas engines for electric lighting are not as popular in this country as in Europe, but there will be many who will read with interest the summary of Mr. Dowson's paper presented in another column. It is contended that a vast saving can be effected by the use of gas engines, and the instances cited in the paper support this conclusion, but the same conditions do not obtain in this country, and it will be a long time before there is the same general use here of gas engines in central stations.

There have been many rulings on the question of the liability of a telegraph company for damages for non-delivery or delay in the delivery of messages. The latest is that reported from Minneapolis, where a physician has recovered damages against the Western Union Telegraph company, the judge ruling that "there could be recovery for mental anguish." The case will be appealed.

Another case in which the same claim was set up by the complainant has just been decided in the Court of Appeals of Texas. An action was begun against a telegraph company for failure to send a message summoning a physician to attend a sick child, causing a delay in the arrival of the physician for several days and until the child was beyond help. The court held that the sender of the message was entitled to compensation, not for the mental suffering which resulted from the sickness and death of the child, but "for the superadded pain and anguish" which resulted from the physician's absence, until it was too late to afford any relief.

The appeal of the American Institute of Electrical Engineers for models, experimental apparatus, books, and other objects of interest for exhibition in its rooms in the electricity building at the World's Fair deserves a cordial response. The rendezvous will undoubtedly prove a great convenience to the members of the electrical profession who visit the fair, especially those from abroad, and with Ralph W. Pope in charge all visitors, whether members of the Institute or not, are assured of a hearty welcome. There is no doubt that many a weary sightseer will find the attentions of the Institute very grateful. We hope that the committee in charge of the enterprise will have no difficulty in securing the desired embellishments for its rooms.

Complaints of electrical engineers and insurance inspectors against the practice of placing isolated lighting plants for office buildings in crowded and undesirable places are beginning to be heeded by architects and builders. A striking example of this is afforded in one of the latest buildings erected in Chicago, the lighting plant for which is illustrated elsewhere in this issue. Every advantage was afforded the electrical engineer to install a first-class plant; suitable location and plenty of room were placed at his disposal, and strange though it may appear, an electrical expert was consulted before the building was erected, his views on the plans were solicited and his suggestions and recommendations were accepted by the owner. This is indeed an age of progress.

Bills providing for the regulation of telephone rates were passed in the upper house of the Wisconsin Legislature on April 5th. These measures were opposed by the telephone company, and while the bills were pending it was announced that their enactment would necessitate the closing of the exchanges at many points throughout the state. It is certainly to be regretted that there is any excuse for legislation on this question, and it is to be hoped, for the general good, that where harsh measures are passed the right of vetoing these bills will be exercised by the governors of the states in which they are enacted. No good can come from the adoption of retaliatory measures even though the legislators may feel that the resentment of their constituents against the companies warrant them in favoring the bills.

After all the tedious legal entanglements that have hindered the development of the secondary battery in this country, it is rather curious that the United States should now bid fair to possess the largest storage battery charging station in the world. This is due, however, to the exigencies of the World's Fair rather than to the normal growth of the industry, and, after the fair is over, it will probably be a long time before a similar installation of equal size is erected in this country. As is well known, no steamboats will be allowed on the lagoons at the World's Fair, and the pleasure traffic on the water will be taken care of by electric launches and Venetian gondolas propelled by sure-enough gondoliers. The batteries of the launches will be charged every night in slips on the eastern and southern sides of the agricultural annex building, and it is this station that is believed to be the largest in the world used exclusively for charging accumulators. Accommodations will be provided for charging the batteries in 60 boats, and as there are 78 cells in each launch it will be seen that over 4,500 cells can be charged at one time, although the maximum capacity may never be utilized. We have therefore to thank the World's Fair for a tremendous spurt in a branch of the electrical business in which it had become notorious that we were lagging far behind European practice. Whether the influence will be lasting remains to be seen.

There is a bill pending in the Illinois Legislature authorizing cities to engage in supplying electric lighting for commercial purposes. This measure is intended to apply to Chicago alone, but if that city can engage in such an enterprise there is no reason why smaller towns may not take advantage of the act and compete with local companies. The constitutionality of such a measure is questionable, and there is no danger that existing companies will quietly permit municipalities to enter the field as competitors without testing their right to do so. But there are other reasons which should deter the legislature from encouraging cities to proceed in this matter. The city of Chicago has been engaged in establishing a system of street illumination for the last four years, and it has made very little progress. As has already been pointed out in the WESTERN ELECTRICIAN, the city lighting department has been hampered by lack of funds. There has been an ordinance before the city council for some time, authorizing the extension of the present system by means of special assessments, but thus far it has been utterly impossible to secure its passage. Generally speaking, the city's streets are poorly lighted, a limited area is supplied with electric lights, but for the most part the city depends upon gas lamps and dirty oil lamps. When Chicago shall succeed in properly lighting its streets it will be time enough to advocate the establishment of generating stations for supplying current to light shops and residences.

In view of the agitation in New York city and elsewhere for cheaper telephone rates, it is interesting to note that the National Telephone company of London has announced that it contemplates making a reduction in its metropolitan tariff for the connection of private residences for domestic purposes to £10 per annum on a five years' agreement, or £12 per annum on a yearly agreement, where the address to be connected is within one mile of the company's nearest exhange. An extra charge of £2 10s. per annum will be made for each extra half mile beyond the distance mentioned. With such an example as this before them, the citizens of New York will undoubtedly continue their fight against excessive telephone rentals with renewed energy. It is true that the expense of conducting the telephone business of New York is great, but it is generally believed that the company could scale down its tariff by a good round percentage, furnish service at least as good as the present, and still be far from bankruptcy. These are times of unrest in the telephone business, and it will be well for the Bell Telephone company and its local dependencies to pay some attention to popular demands. Of course such a thing as a voluntary reduction of rates would be a painfully radical departure from the policy of the company; but while such a procedure would undoubtedly be accompanied by much mental distress at first, it could not fail to prove a good stroke of business. The New York and other local companies in this country may well take a leaf from the book of the London corporation.

Once more the people of New York are discussing the advisability of building an underground railway system to secure rapid transit. A majority of the members of the commission have always favored this plan, the only obstacle being their inability to secure responsible capitalists to undertake the work. It is estimated that $50,000,000 will be required to construct and equip an underground system, and with the opposition of the powerful Manhattan company it has thus far been impossible to secure the necessary funds from private capitalists. A scheme has been devised by a prominent banker, who announces his readiness to invest $15,000,000 in such an undertaking, provided arrangements can be made to secure the city's assistance in raising the additional $35,000,000. It is known that the city is prohibited from lending its credit to such an enterprise, and it is also prohibited from taking any financial interest in such undertakings, but the advocates of this project hope to devise some scheme by which the city shall build the road, raise the money for the work and turn the enterprise over to the company, the latter indemnifying the city against all loss. It is claimed that the city can secure money at 3 per cent. while a private corporation would be obliged to pay a much higher rate of interest; in fact, the interest which would be required on money loaned for such an undertaking would more than exhaust the profits of such a road for many years. This is really the only objection to the underground plan. It is a curious fact that the advocates of the "L" system are constantly harping on the good service and superior advantages of the elevated roads, yet for more than twenty years the people of New York have been clamoring for an underground system. If the "L" roads were all that is claimed for them the people would not still be looking to an underground system for relief. The same arguments that were advanced in 1869 hold good to-day. The "L" roads afforded temporary relief, but no one who has hopes for the future greatness of New York will contend seriously that the city can retain its present position as the foremost city of the country unless better rapid transit facilities are afforded than those furnished by the Manhattan company.

Photometric Standard for Arc Lamps.

M. Blondel has recently called the attention of the International Society of Electricians at Paris to the necessity of establishing a new photometric standard for arc lamps. The plan which he proposes is to be submitted to the Electrical Congress in Chicago, and M. Blondel has expressed the hope that this body will take it under serious consideration. The proposition which he intends to lay before the congress is as follows:

"To facilitate the photometric measurement of arc lamps and to form the basis of a comparison which shall be better than the ordinary flame, there should be, for this special case only, a secondary standard called the 'arc standard', defined as the luminous intensity of a given surface of

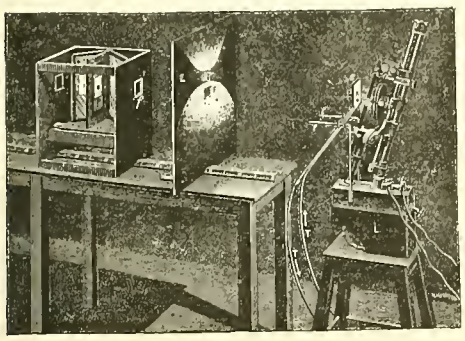


FIG. 1. PHOTOMETRIC STANDARD FOR ARC LAMPS.

pure carbon raised to the temperature of volatilization and obtained in a manner to be determined later.

"The mean value of this secondary standard would be established once for all in well defined conditions—that is to say, for a series of absolute known values of light.

"As to measurements, they will be expressed in decimal candles, but with the phase added 'in accordance with the arc standard.'"

As it has been stated, M. Blondel discussed this subject before the International Society of Electricians, and at the same meeting he described and illustrated the form of photometric apparatus that he recommends. The principle of the method proposed and employed by him consists in isolating on the crater of the positive carbon a given emission surface. The spectral composition of the light of the crater, and consequently its temperature, remain, constant and independent of the current strength, in accordance with the experiments of M. Abney and M. Violle. Experiments made by M. Blondel and M. Le Chatelier have shown on the other hand that the intrinsic brightness of the crater within considerable ranges of potential difference, current strength and of the character of the carbon remains constant, or at least have proved that the results are practically concordant, the variations being irregular and not exceeding the errors of difficult experiments. At all events, the variations are very small, and will be absolutely negligible in practice when the same qualities of carbon are used.

Blondel has obtained a practical standard based upon experiment by using an arc lamp with oblique carbons with a controllable luminous point, and with a screen equipped with a variable diaphragm, Fig. 1. This lamp is one of the Sautter-Harle projectors, the carbons of which are inclined 20 degrees from the perpendicular, and the crater presenting an inclination of from 50 to 60 degrees. The crater is completely defined when the arc is from 4 to 5 millimeters in length.

The opaque screen E is a flat box which is kept cool by a stream of water running through the pipes T T, Fig. 1. It can be adjusted horizontally by sliding it along the rods t t, Figs. 1 and 2. At A is a small conical opening. Back of the box is a diaphragm D containing a certain number of small openings. The latter measure about one square millimeter. When the opening in the diaphragm is placed at the height of the center of the crater C, and from two to three centimeters from it, there is obtained a conical pencil of light which is very divergent, the crater forming the base of the cone and the little opening the point. The intensity of the ray in a horizontal direction is equal to the product of the intrinsic brightness of the corresponding part of the crater and the surface of the opening employed.

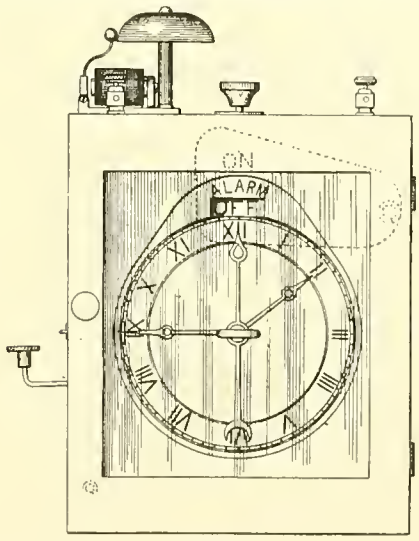
This arc standard is employed in the same way that any other standard is used, taking care, however, that the horizontal rays falling on the photometer proceed from the portion of maximum brightness in the crater where the luminosity remains constant, as is represented in Fig 1, showing the entire apparatus. The operator assures himself on this point by adjusting before the opening of the screen a small lens e, Fig. 2, which projects on the screen E a clear image of the crater. This result is obtained by producing a crater which shall be constantly and uniformly illumined by a current of 70 or 75 volts and two tenths of an ampere per square millimeter of carbon. With carbons 15 millimeters in diameter, there may be produced with a current of 40 amperes an arc of 5 millimeters, but it is sufficient to use carbons 10 millimeters in diameter and a current of 25 amperes, if the carbon is of good quality. The illustration is reproduced from *L'Industrie Electrique*.

New Electric Signaling Apparatus.

The traveling public is always looking for something which may add to its comfort and convenience, and for several years the proprietors of hotels and office buildings have been vieing with each other in an attempt to provide the latest improvements for their patrons. A valuable addition to this class of novelties is presented in a new electric signaling apparatus invented recently by Wesley Trafford of New York city. As a hotel time-call its use will not only relieve the office staff of a portion of its duty, but will make it unnecessary for the guest to go to the office, and at the same time will afford him the satisfaction of not being obliged to depend on negligent clerks.

The invention relates to that class of apparatus which is employed in producing signals in the rooms or apartments in such large establishments as hotels, flats, factories and similar buildings, and more particularly to that kind of apparatus in which the signal is conveyed to the several rooms from a central station or main office by means of an electric circuit. It embraces a multiplex signaling apparatus consisting of sub-station alarm apparatus contained in separate rooms, the action of which is governed from a central station or main office by means of an electric circuit controlled by a clock, both as to the time and duration of the alarm. It further comprises a cut-out device whereby the main electric circuit current is rendered ineffective in each sub-station signal apparatus when its alarm indicating pointer is at the neutral or unit point.

To the general circuit is attached a fire-alarm call, an annunciator system and an automatic electric light switch. Unlike most call systems, this one acts as an electric time piece for every room, and always shows the same time as the office clock. The face of each instrument represents



NEW ELECTRIC SIGNALING APPARATUS.

an ordinary clock dial, but having three hands instead of two, as shown in the cut. To set the alarm the pointer is fixed at the time desired, and when the hands of the central time-piece arrive at that point the electric alarm, which may be placed in any portion of the room, rings for any length of time desired. The clock automatically winds itself, so that it is always a ready and ever watchful servant.

By the use of the annunciator system the guests can call up the office at any time, while the office is enabled at a moment's notice to arouse the guests simultaneously. For use in hotels where the buildings are already wired the new system will prove most adaptable, as no extra wiring is necessary.

The Edison Electric Light & Power company, of Meridian, Miss., has been awarded the contract for city lighting, the bid being $5.94 for all night lighting and $4.94 formoonlight schedule.

Book Table.

PATENTABLE INVENTION. By Edward S. Renwick, Rochester, N. Y.: Lawyers' Cooperative Publishing company.

Some very important topics are considered in this work, giving it additional value from that which it possesses by reason of the concise manner in which it deals with the main subject. The author believes in giving whatever protection is afforded under our patent system to every improvement and discovery that may be made. It is by the minor improvements and advances chiefly that progress is made in the arts, and, therefore, it is contended that every encouragement should be given to inventors and mechanics to stimulate them in this line. It is often claimed that changes upon which patents are demanded do not come within the class of invention, that they are obvious improvements and could be made by any skilled mechanic. To this objection the reply is made that if the change was really obvious, it would have been in use before. Moreover, opinions expressed as to the obvious-

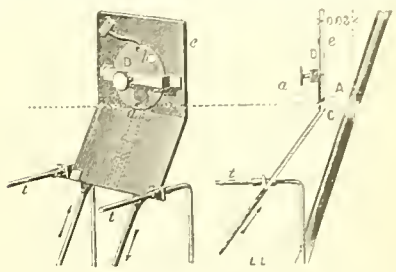


FIG. 2. PHOTOMETRIC STANDARD FOR ARC LAMPS.

ness of patented changes are opinions formed after the event, and especially where the change is simple the average mind does not recognize the display of inventive genius which brought about the improvement. Judge Story's view on a case of this kind is that where a change "is new, if it is useful and if it has not been known or used it constitutes an invention within the very terms of the act." The question of what constitutes changes which come within the range of invention is very fully discussed. The author recognizes that many complications are liable to arise through the inconsistency of the opinions of the present judges. Already there are many conflicting rulings, and with the creation of nine appellate courts, the possibility for further complication and friction is certainly not at all reassuring to the inventor with limited backing. In view of these facts it is considered advisable to adopt some general rules by which the courts may be guided in their decisions. Mr. Renwick strongly advocates this policy, and his experience and knowledge should lend additional weight to his arguments.

Another point of general interest which the author brings out most forcibly is that an inventor generally does not know when his patent is issued whether it really covers the essential features of his invention. Of course this is due in the main to the fact that the technical language in which the application is couched is unfamiliar to him, and if he is deceived it is not to be wondered at, when learned judges, with years of training and experience, and with the aid of experts, frequently differ as to the construction to be placed on the claims and specifications. The author contends that the "actual invention is rarely set forth correctly in an original patent." On this point he says: "With those who have had experience in the methods in which applications for patents are prepared and acted upon in the patent office, the general understanding is that the real legal invention made by an inventor is rarely set forth in his original patent. (1) Because a majority of the specifications of patents are prepared by persons who have had no experience in the courts, and therefore do not appreciate the necessity of the utmost care in doing the work, and who, if able to determine what the real legal invention is, generally do the work of preparing an application for so small a compensation that they cannot afford to expend the time and labor required to ascertain it. (2) Because the practice of the majority of the examiners of the patent office for many years has been never to grant a claim broad in its scope if by repeated rejections they can get an inventor or his solicitor to take a narrow claim, and as many solicitors receive a fixed sum for soliciting a patent, it is the policy of many of them to take any claims they can get through the patent office with the least expenditure of time and labor, whether such claims cover the real invention or not."

Throughout the work the views and arguments of the author are presented in concise form, and in language which is intelligible to the layman. Numerous cases are cited in support of the author's views, and it is a noteworthy fact that the inconsistencies complained of are found in rulings which conflict with those of Story, Marshall, Nelson and Curtis. This is especially true in the construction which has been placed upon the act relating to reissues in decisions handed down since 1880.

The book is divided into three parts. Part I treats of "Patentable Invention;" Part II, "Inventions Patentable by Law;" Part III, "Invention Patentable in a Reissue Patent."

ELECTRICAL TABLES AND MEMORANDA. By Silvanus P. Thomson and Eustace Thomas. London: E. & F. N. Spon; New York: Spon & Chamberlain. Price, 50 cents.

This little book belongs to the "vest pocket" class of publications and contains valuable tables and rules for wiring. A summary of the Phœnix fire office rules is presented, together with other data that will prove instructive to constructing engineers. Hints on wiring methods, on dynamos, motors and accumulators are also given.

Underground Rapid Transit Proposed for New York.

The project for building an underground system of railways that would afford rapid transit facilities to the people of New York has been revived. At the meeting of the rapid transit commission last Saturday a proposition was presented by which it was proposed to organize a company capitalized at $15,000,000 to secure the franchise and operate the road. Two communications were received from A. T. Wilson & Co., New York bankers representing J. J. Astor, G. G. Hazen and other capitalists. The capitalists express themselves as favorable to underground railroad. They say:

We believe a system of underground railroads would meet the requirements of the city of New York much better than any other that can be devised; and, while we are aware that there are grave doubts resting in the minds of capitalists as to whether or not a system of this kind would give a proper return upon the capital required, owing to its probable very heavy cost, and while we admit that this doubt is, perhaps, not without foundation, we believe that a careful investigation of the subject would remove these doubts, at least to a great extent, provided some method for raising the necessary capital at a low rate of interest could be devised.

Here is the method proposed for raising the funds necessary for the construction and equipment of the road:

First—We and our associates will form a corporation with a cash capital of $15,000,000 to build the proposed railroad for the account of the city, the city paying seventy per cent. of the actual cash cost of the same in its bonds at par, upon the condition that the city will contract to sell to said corporation, or to another corporation to be formed, the railroad after it shall have been built, at a price equal to the bonded indebtedness incurred by the city in the construction of the same and accept payment therefor by the purchasing corporation assuming the payment of the principal and interest of said bonds of the city, which bonds shall at the time and as the same are issued by the city constitute a first mortgage lien on all the property of the corporation; and the purchasing corporation shall establish a sinking fund adequate for the ultimate retirement of the bonds. If the above plan does not offer a satisfactory solution of the difficulties, we suggest the following alternative plan:

Second—We and our associates will form a corporation to purchase a franchise under which said corporation will build, own and operate that part of the proposed route from the Battery up Broadway to Fourteenth street, including the loop to the Brooklyn Bridge, upon the condition that the city shall build from Fourteenth street to 190th street, or to the city limits at its discretion, and also the branch from Fourteenth street up Fourth avenue to the Grand Central Depot, as outlined in your plan, and, when completed, shall sell such portion built by it to the corporation for a sum equal to the total amount of bonds issued by the city for the construction of the same, and accept payment therefor by said corporation assuming the payment of the principal and interest of the bonds of the city, in the manner stated in the previous proposition.

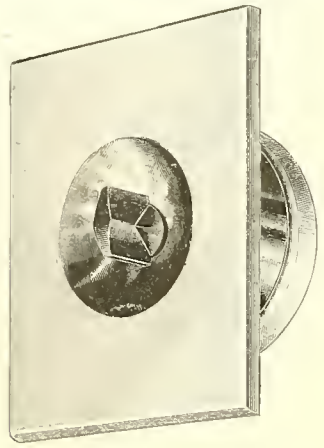
If either of these alternative propositions can be carried out, we stand ready, for ourselves and associates, to make a deposit of $1,000,000, or such other sum as may be thought reasonable, to guarantee the engagements which it is proposed to enter into.

Under the above propositions, it will be seen that the city is amply secured, as it will hold a first mortgage lien on property costing 100 per cent. for every 70 per cent. which it shall advance.

The maximum amount to be advanced by the city is limited under any circumstances to $35,000,000; and if, as we believe to be the case, the city's three per cent. bonds could be sold at par, the annual interest charge could not exceed $1,050,000, while at a very low estimate the net earnings of the property would be far in excess of that amount.

As a part of the above propositions, it is intended to establish a sinking fund adequate for the retirement of all the obligations which it is proposed the city shall incur; hence it will be seen that before the city could be called upon for the payment of one cent of either principal or interest of the indebtedness incurred, the $15,000,000 contributed by ourselves and associates would have to be an utter loss.

This plan was received with favor by the commissioners who had not, it was evident, lost faith in the superiority of an underground system. The only objection raised was whether the plan proposed would not be considered unconstitutional. The city of New York is prohibited by an act passed in 1885 from lending its credit to any corporation or becoming a partner in any enterprise promoted by private capital. The attorney for the commission said on this point. "The question here is whether or not the courts would decide that their plan was an evasion of the constitution. Is it not, as a matter of fact, a plan to induce the city to lend its credit in evasion of the constitution, and will not the courts decide it in that way?" The commission adjourned without taking any action on the proposition.



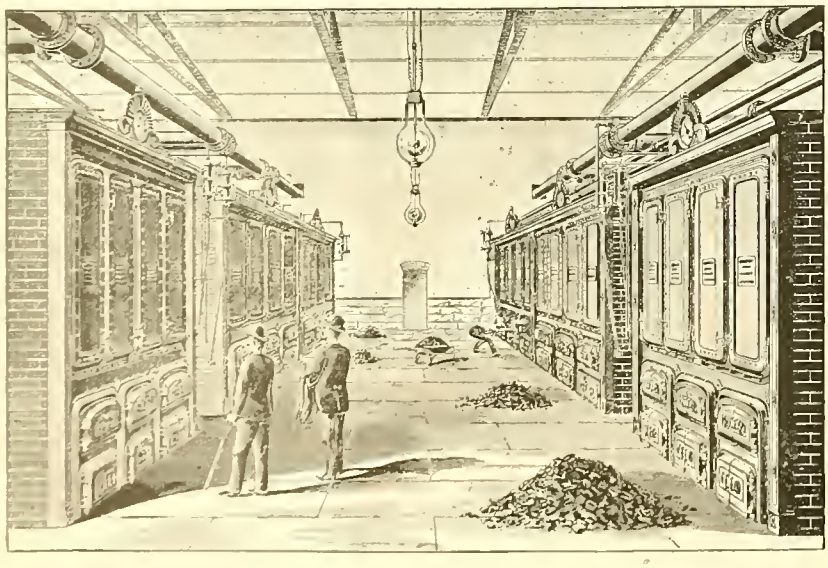
THE HART FLUSH SWITCH.

Concerning Mr. Wilson's proposition there is of course a diversity of opinion. The *Times* says editorially:

The proposition made yesterday by R. T. Wilson to the rapid transit commissioners may be accepted as conclusive evidence that capital for an underground road can be obtained, if by any means the aid of the city can be given to keep the interest on some 70 per cent. of the $50,000,000 needed down to 3 per cent. That is about what the proceedings yesterday disclosed. Mr. Wilson's counsel and the counsel of the commission are to study the legal questions involved and report on Tuesday at the next meeting of the board. As it is perfectly plain that no adequate system of rapid transit can be got by any extension or modification of elevated railroads, this proposition deserves the most careful consideration. It has every appearance of being made in good faith, and it is the first of which that can be said that has reached the light since the opening of this year.

Of course the *Sun* throws cold water on the project. It was not to be expected that it would grow enthusiastic over any scheme that would interfere with the plans of the Manhattan company. In its editorial comments it says:

It is useless to talk of underground rapid transit and show only fifteen million dollars' worth of capitalists, instead of fifty millions worth, the minimum required. The idea of founding an enterprise on a small amount of private money in combination with a great deal of public money, is not to be entertained. The city cannot go into the railroad business on its own hook or with partners. Moreover, the city cannot properly make a covenant with an underground company not to grant a franchise afterward for an elevated road over the same streets. That would be equivalent to making the same terms with a horse-car railroad. When the elevated roads were building the Sixth avenue horse-car line undertook to stop them, on the plea that their rights were invaded, but that view was rejected for the public benefit, and any such bargain as that suggested, in order to fortify the confidence of these underground capitalists, will stand upon the same untenable footing. Let capitalists build as many underground roads as they like, but there can be no treaty with them to hamper the requirements or judgment of the future in the matter of extending travel in the light and air of heaven.



MODEL STEAM PLANT FOR AN ELECTRIC LIGHTING STATION.

Telegraph Rates Between Points in North Carolina.

The question of regulating telegraph rates and the right of the state to fix a standard of charges for transmitting messages between points within the state has occupied the attention of the North Carolina courts during the last year. The state railroad commission last year fixed the rate of messages, not exceeding ten words, from one point to another, both the transmitting and receiving offices being in North Carolina, at 25 cents. Recently a message was filed at Elizabeth, N. C., for Winston, N. C., for which an extra charge was made on the ground that the message was transmitted by way of Richmond, Va. The matter was brought to the attention of the railroad commission by E. P. Albea, the sender of the message. The commission ruled that the telegraph company had no right to impose an extra charge and it was agreed to submit the matter as a test case to the courts. The appeal was argued at Raleigh recently and was decided on April 3d, the court sustaining the position of the commission. Judge Brown, who wrote the opinion, is an old telegrapher and in deciding the case said that "even if the circuit was broken at Richmond, of which there is no evidence, the passage of the message would still be continuous; relaying a message is simply transferring it from one wire to another, just as cars are transferred from one track to another; if the matter were looked at in any other way, the telegraph company could easily make a great part of its North Carolina business inter-state."

New Telephone Company for Chicago.

The Chicago city council has given a franchise to the Chicago Twin Wire & Long Distance Telephone company, which agrees to have 5,000 telephones in operation in the city by December, 1895. The ordinance authorizes the company to construct and maintain a line of wires and conduits for telephone purposes. In the district bounded by Belmont and California avenues, Sixty-ninth street and the lake the wires are to be placed underground. Outside of that district they may be overhead, but all wires must be buried within seven years, and the company agrees to place its pole lines in alleys wherever possible. The company gives to the city the right to use the top arm of all the posts it erects for city telephone and telegraph wires. The rates are to be not to exceed $75 for each instrument for the first year, $70 for the second and $65 for the third. To the city offices there are to be no charges. Five per cent. of the gross receipts is to be paid semi-annually to the city. The city is given the right of purchase after five years. If the franchise is transferred it is to be declared void.

Journalistic Courtesy.

If the *Electrical Engineer* had made the request, we would have cheerfully loaned it the illustration to accompany the item, "An Electric Safety Curtain," the text of which it borrowed from our issue of February 22d without permission and without acknowledgment.—*Electricity.*

And the WESTERN ELECTRICIAN would have gladly loaned to either or both of its esteemed contemporaries the illustration of the same curtain, reproduced from *La Nature*, in its issue of February 11th. A comparison of the cuts will show at a glance that both of our contemporaries have missed an excellent opportunity to embellish their pages with a really artistic illustration.

Electric Railway Lines for Chicago Suburbs.

The Chicago city council last Monday night passed an ordinance providing for an extensive network of street railroads operated by electricity south of Sixty-third street and extending to the Calumet country. The lines connect South Englewood, Washington Heights, Brainerd, Auburn Park, Eggleston, Normal Park, Park Manor, Brookline,

Grand Crossing, Woodlawn Park, with the World's Fair grounds, the alley "L" road at Sixty-third street and Vernon avenue, and with the lines of the Chicago City railway at its various termini.

The Hart Flush Switch.

The Hart flush switch, illustrated herewith, is manufactured by the Hart & Hegeman Manufacturing company, Hartford, Conn., and is now ready for the market. It has several points of merit, is neat and attractive, and is finished in any style desired. The switch proper is attached

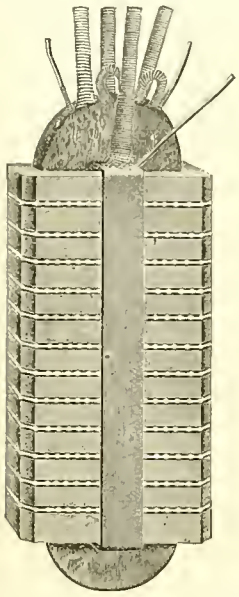


FIG. 1. DEVELOPMENT OF THE TRANSFORMER.

by two screws with a cast-brass plate, from which it is readily detached for wiring, and is protected from injury and dust by a surrounding brass shell attached to the back of the cast plate. The cast plate with switch attached is screwed to the wall, and a finished cover of heavy sheet metal with flanged edges is put on over the cast plate and held in position by the switch handle. No screw heads show on the surface of the finished cover, thus avoiding the necessity of special screws to match the finish of the cover. An assortment of finished head screws of different lengths to suit different requirements is unnecesary, for, as they are not exposed, common flat head screws of convenient lengths may be used for holding the plate to the wall. The flush plate illustrated is adapted for use with the regular Hart snap switch of the following sizes: Five and ten ampere single-pole, ten ampere double-pole, and ten ampere three-way switches.

Model Steam Plant for An Electric Lighting Station.

The plant of National water tube boilers, now in use at the station of the United States Electric Lighting com-

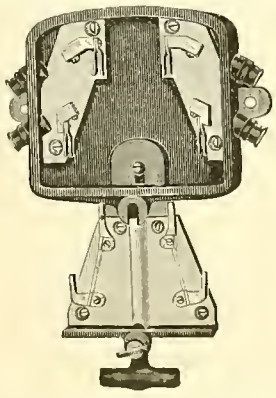


FIG. 3. DEVELOPMENT OF THE TRANSFORMER.

pany, Washington, D. C., is illustrated in the accompanying cut. There are six boilers aggregating 2,500 horse power, nominal, with an effective capacity largely above that amount. The boilers are of the well known National water tube type, made at New Brunswick, N. J., and were especially designed to give a large amount of power within a limited space. This is accomplished by massing in each boiler a large amount of heating surface, while retaining all necessary advantages of access for examining and cleaning both externally and internally. The construction of the National boiler permits this adaptation to local surroundings and where necessary the space required for a large plant may be greatly reduced. Each of the boilers of this plant has three storage drums giving ample storage capacity, even where the demand for steam is sudden and heavy. Each boiler is set independently and has independent steam and water connections, in order that one or more may be shut down for cleaning and examination without disturbing the others. Each boiler has three furnace openings, allowing one-third of the grate to be cleaned or replenished without disturbing the balance. Ample cleaning doors are provided in the sides of the boiler walls, through which all parts requiring cleaning may be readily reached, and the large door provided at the rear of each boiler setting allows free entrance to the rear of the boiler and flue. The ordinary working pressure is 140 pounds to the square inch, but the limit of safety is largely above that pressure, and the working pressure may be increased if desired. The engine plant of the United States Electric Lighting company comprises compound engines of the most modern type, and the best results in modern steam engineering are reached.

Development of the Transformer.

The advancement of the alternating system of incandescent lighting has been very rapid in the last few years, and this has been due largely to the remarkable efficiency developed in transformers. Next to the dynamo itself, the transformer may be said to play the most important part in the system.

The essential characteristics of a good transformer are perfect safety, high efficiency, good regulation, small core loss, and convenience of installation. In the "F" type of General Electric company transformers, the first requirement is attained by the best mechanical means, aided by the use of oil; by the provision of a core ground wire, by the subdivision of the primary and secondary coils, and by the absence of all fuses in the transformer case. When the case is filled with high grade mineral oil, the coils and core are entirely immersed; with the result that should lightning strike one of these transformers and injure the insulation in any way, the oil would immediately flow in and restore the apparatus to its original condition. These oil filled transformers have been subjected to numerous stringent tests, and it has been found necessary to increase the potential to more than 11,000 volts before the insulation between the coils could be broken. After allowing

FIG. 4. DEVELOPMENT OF THE TRANSFORMER.

the apparatus in which the insulation had just been broken by this high potential to stand a short time, the test was again applied, and not until the potential had been increased to over 5,000 volts did the insulation give way the second time. The value of oil as an additional insulator may, therefore, be said to have been conclusively proved. Should lightning break through the insulation of the primary coil, it is carried at once to the earth by the core wire, which should be carefully grounded. Furthermore, the primary coils are themselves sub-divided. By this means, the greatest difference in potential existing between any two parts of the primary and secondary windings is only half the primary voltage, the secondary winding being the nearer to the core. The absence of fuses in the transformer case obviates the necessity of opening the case, and eliminates whatever danger might be caused by the molten metal of the blown fuse. The fuses, in a separate box, non-combustible and water-proof, together with the primary switch, are placed in an easily accessible position, thus allowing regulation of the transformer free from disturbance. The fuses are covered with rubber tube, and it has been shown by actual test that where a certain potential will form and hold an arc in the open air across a space of seven inches, the use of tubing hinders the formation of an arc under the same potential, even across the small space of one and three-quarter inches. On systems using potentials of over the regular 1040 volts, two single pole boxes are employed.

The efficiency obtained in this transformer has been shown to be as high, if not higher, than any yet obtained, with an excellent average at all loads. It will be seen by the following table that the larger the transformer, the greater is its efficiency:

Watt Capacity.	¼ Load.	½ Load.	¾ Load.	Full Load
600	84.1	90.95	93.	93.8
1,600	88.2	93.	94.	94.7
1,500	90.	94.	94.95	95.23
2,500	90.25	94.32	95.45	95.74
3,500	93.0	95.7	95.8	96.
4,500	93.9	96.3	96.85	96.96
7,500	92.2	95.8	96.4	96.85
15,000	91.5	95.3	96.3	96.5
30,000	93.3	95.9	96.8	97.2

Practical uniformity of potential on the secondary winding throughout the range from full load to light load is the test of regulation of a transformer, for the difference of only a few volts on the secondary winding from the normal means either unsatisfactory light or a shortening of the life of the lamp. It is to this point that the General Electric company has given much attention, with the result that its transformer gives no greater drop in potential than that shown in the following table:

52 Volt Secondary.

Capacity in Watts										
Drop of Potential in Volts										

104 Volt Secondary.

Capacity in Watts										
Drop of Potential in Volts										

Core loss is an element in transformers due to hysteresis, or molecular friction due to rapid reversals of polarity and foucault or "eddy" currents. Its elimination is a problem which presents considerable difficulties, and, although

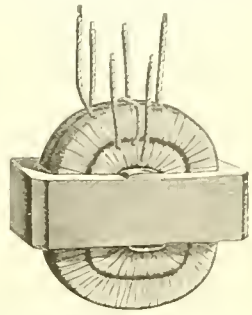


FIG 2. DEVELOPMENT OF THE TRANSFORMER.

it is almost impossible to prevent the loss entirely, the apparatus under consideration shows that that loss is extremely small.

The tendency of present practice is the substitution of a few large units for a large number of small ones at points having a sufficient number of lights to warrant this step. This marks the abandonment of the idea that the transformation of a large amount of electrical energy in one large piece of apparatus is less reliable and more dangerous than that made by means of a number of smaller pieces. The excellence of construction of the larger devices has served to dispel this idea, and the larger transformer is undergoing steady and rapidly extending adoption. The larger transformers constructed by the General Electric company are designed for a transformation of 15,000 and 30,000 watts. Their size necessitates a sub-division of winding. In the 15,000 watt transformer both the secondary and the primary coils are each subdivided into two parts; in the 30,000 watt transformer the primary winding consists of three and the secondary of two separate coils. By this means satisfactory regulation is obtained. In these, as in smaller sizes of transformers, provision has been made for a perfectly free circulation of the insulating oil about the different coils. The larger sizes have no connection boards, the terminal wires being brought out at the

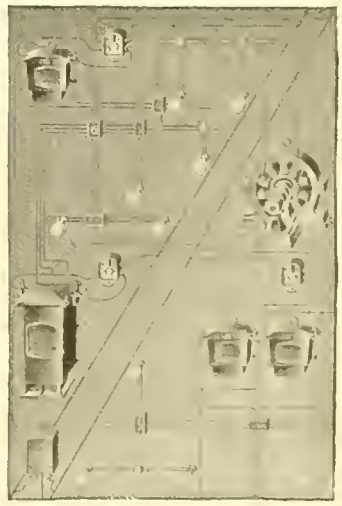


FIG. 5. DEVELOPMENT OF THE TRANSFORMER.

top of the case for connection through suitable switches and fuse boxes to the primary and secondary wires.

In the accompanying cuts, Fig. 1 represents the interior of a large transformer, while the interior of a smaller converter is illustrated in Fig. 2. A switch box is shown in Fig. 3, the type of fuse employed is presented in Fig. 4, and a diagram showing a transformer installation is presented in Fig. 5.

The illustrations show the method of construction of the transformers. The laminated core is securely fastened into the iron case by means of wooden wedges,

which serve as insulation between the coils and the case. The cover to the case is slightly arched and flanged in order the better to protect the interior from mechanical injury. Each transformer is subjected to an insulation test of 5,000 volts before it is allowed to leave the factory.

The advantages to be derived from the use of large transformers are numerous. Small transformers in parallel are apt, from various causes, to give trouble by unequally dividing the load between them; and the combined efficiency is always less than that of the single transformer equal to their aggregate capacities. From a large transformer a three-wire system may be operated directly from its secondary terminals. But few people appreciate the advantage of using a high potential on the secondary winding where a large number of lamps are to be installed at one point; and yet this can be shown as follows:

With 500 lights installed on several transformers in parallel, having a potential of 50 volts on their secondary wires, there is a drop of potential in the secondary system from no load to full load of about 6 per cent. The substitution of a large transformer, with its secondaries connected for 104 volt lamps on the three-wire system, will reduce the drop in potential from 6 per cent. to about half of 1 per cent. This drop is far less than is necessary for satisfactory operation, and it is therefore possible to install the system for less than half the cost of wire of a system with small transformers using a 52 volt potential and 6 per cent. drop.

The system of long distance transmission as employed by the General Electric company is that of using generators which give a potential of about 1,000 volts, and large transformers adapted to raise the potential to 5,000 volts or higher. The current thus transformed is transmitted over wires supported upon oil insulators, to the distant receiving point, and is there re-transformed to a lower potential. The line insulators employed consists of a wide glass cup with an inner flange which dips into a ring shaped glass oil cup threaded onto the insulator pin. This construction effectually prevents any leakage of current from the wire to the supports, even in wet weather. The transformers are the same as the standard type "F" transformer except in the method of winding and insulating coils The use of oil in this long distance transmission apparatus is considered extremely desirable because of the high potential of the "step-up" circuit; and the protection it affords against injury to the insulation of the coils can not be overestimated.

Both the primary and secondary coils of the long distance transformers are so wound as to secure the greatest possible inductive effect without any sacrifice of insulation. Mica is freely used, and the greatest care is taken both in winding and assembling to make the insulation as perfect as possible. This insulation is in all cases tested to withstand an alternating potential difference of at least 10,000 volts. The transformers are alike, with the exception of a modification in the winding, whether intended for "step-up" or "step-down" work, the primary of the "step-up" corresponding to the secondary of the "step-down." The standard size is 25,000 watt capacity, and larger sizes will be built if desired. It is not considered advisable, however, to build smaller sizes than this.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 8.—The plans of the Manhattan company for an extension of its "L" system were all but approved by the Rapid Transit commission, and but for the uncompromising opposition of Commissioner Starin would in all probability been accepted. Now, however, there seems to be considerable doubt, and already Manhattan stock has felt the effect of this opposition. Mr. Starin's statement that he had assurances from capitalists that they would invest $15,000,000 in an underground system for rapid transit was at first ridiculed by the Manhattan's advocates, but on Saturday last it was found that these capitalists were in reality some of the city's wealthiest men.

In the meantime the Manhattan company continues to push its claims. Three of the rapid transit commissioners, Messrs. Spencer, Inman and Bushe, are on record in favor of the Spencer-Bushe plan, which calls for an elevated extension from the Manhattan at 129th street through the boulevard to 170th street and thence by the Kingsbridge road to the city limits. The other two commissioners, Messrs. Holloway and Starin, voted against this plan, because as they said, they were opposed to the use of the boulevard. Mr. Holloway admitted that he might withdraw his objection if it should appear that a majority of the boulevard property owners were not opposed to the road.

Since this announcement he has been deluged with letters from property owners on the boulevard petitioning him to vote for the extension of the "L" system. The *Herald* last week undertook to secure an expression of opinion from property owners. It was not possible to trace within a limited time the owners of every foot of abutting property from 108th to 170th street, but the canvassers succeeded in finding and polling the owners of more than eighty-six per cent. of the entire frontage. Of these, nearly eighty-three per cent. express themselves as either in favor of or not opposed to an elevated road in that part of the boulevard. This constitutes more than seventy-one per cent. of the entire ownership from 108th to 170th street, a distance of more than 3 miles, and shows only thirteen per cent. of all to be opposed to such a structure. The greater part of this small percentage represents Columbia College and Trinity Cemetery. Concerning the opposition from the advocates of underground roads, the *Herald* says editorially.

Relief is urgently needed at once, and must be provided at once. Rapid transit for the future will come in good time. We can wait for that. Rapid transit for the present is a pressing necessity. It must be provided first. It demands immediate attention. The people want the commissioners to give them rapid transit at once, before taking up a scheme which promises no relief for ten or fifteen years.

The legislative committee considering the bill providing for a reduction of telephone rates in this city held an important meeting last Thursday. G. Waldo Smith, appearing for the advocates of the measure, said that there could be no question that the telephone companies were subject to legislative control, as the gas and railway companies were. The telephone company of New York city began by charging $60 a year, and had increased its charge until it is now $240. He had investigated telephone charges in Europe personally, and had found that they were as follows: London, $100; Paris, $80; Berlin, $80; Naples, $25; Rome, $20; and Switzerland from $19 to $24. The net profits of the Metropolitan company last year were about $3,400,000.

The Metropolitan company presented the following statement as its argument against the bill:

The annual net earnings of the telephone business in New York city for the past two years have not averaged six per cent. per annum on the actual cash capital invested in the plant. In the investment above referred to no real estate or other property not necessary to the safe and successful operation of the business has been included. The dividends which have been paid upon the capital stock of the telephone company since its organization average less than 7½ per cent. per year. The capital is not watered. The management aims to furnish such an equipment and such an organization as will best supply the best attainable telephone service. Subscribers are supplied with metallic circuit equipment and service for $150 per year or with a special direct line for $240 per year, and they are at liberty to select whichever of these classes best suits the requirements of their business. Every subscriber who has a metallic circuit equipment can talk from his own office to all points reached by the long distance lines. This is a facility not attempted to be furnished in any foreign city. A large number of the public stations have been established at convenient points, from each of which communication with the entire telephone system may be obtained upon the payment of a small fee for each communication. It is, therefore, not necessary for any one to become a regular subscriber to obtain the benefits of the telephone service. The average daily use of the telephone by each subscriber in New York city is very much larger than in any other city in the world. The actual cost to the company of maintaining telephone service in New York city per subscriber is vastly greater than that in any other city in the world. There are many very large items of expense necessarily incurred in furnishing the service in New York city which do not appear at all in the cost of operation in smaller places, and there is no single item of expense which is not much larger, per subscriber, in New York than in other places. The rates charged for telephone service in New York city are no higher—whether considered in relation to the benefits obtained by the subscribers or in relation to the cost of furnishing the service—than they are in the smaller cities.

The representatives of the subscribers asked that the statements of the company be subjected to a rigorous investigation. "I can assure the committee that there are seven thousand solid business men in the Telephone Subscribers' association," said Mr. Smith; "the other six thousand people who use telephones in New York are of the class that care nothing about the charges. I also call the committe's attention to the Ainsworth report in 1885, which showed that the telephone company made over 116 per cent. net profit. This commitee should at least investigate if it is in doubt as to the facts."

The fire in the car house of the Orange electric line in Newark, April 3d, reported in the last issue of the WESTERN ELECTRICIAN, was most disastrous. Twenty-six cars valued at $3,000 each, two sweepers, and a number of sets of the interchangeable parts of the power machinery were destroyed. The building with its contents was the property of the New Jersey Traction company, and it is estimated that the loss will reach $150,000. Many of the cars were new, some of them never having been used. The loss is largely covered by insurance. The service on the Orange line will be very much crippled by the destruction of the cars until the company can replace them. Even with all the cars in service that the company owned before the fire, the facilities were totally inadequate, and new cars are being added to the equipment in order to accomodate the travel. The cars already ordered will now be hurried forward to completion as quickly as possible.

The application for a franchise for the Nassau Electric Railroad company of Brooklyn was heard by the railroad committee of the Brooklyn Board of Aldermen on the evening of April 7th. The routes asked for are substantially the same as those for which the Kings County electric road, as the Nassau was formerly called, applied some time ago. Protests were made by Assistant District Attorney John F. Clarke, in behalf of the residents of South Fifth street, and by the Brooklyn City Railroad company, which offered $150,000 in cash for a franchise to use the same streets that the Nassau company asks for. James C. Church, counsel for the applicants, said that the Nassau people were prepared to begin work within thirty days of the granting of the franchise. W. F. O.

Northwestern Notations.

MINNEAPOLIS, April 8.—A party of electricians and engineers from Minneapolis paid a visit a few days ago to the plant of the St. Paul Gas Light company to examine the new machinery the company has just put in. A compound engine of 1,300 horse power has been placed in position to run the 18 dynamos in use from 6 P. M. till midnight. Interest centered in a belt encircling one of the big fly wheels which is 6 feet wide, 175 feet 8 inches long and a quarter of an inch thick. It is an endless belt without a rivet, and was made by a Chicago firm. It is the main driving belt of the power house and is used on the 22 foot drive wheel. This wheel is so heavy that after the steam is cut off it continues to spin three-quarters of an hour. The surface on which the belt runs is 73 inches wide.

The St. Paul authorities are considering the advisability of appointing a superintendent of electricity to inspect wires, public and private. The sentiment seems strongly in favor of having such an officer, but the precise relations of such an official to the building inspection department and the extent of his authority are matters in question. The ordinance now pending provides for the careful insulation of all wires, and for the cutting out of all dead or unused wires. This item has been objected to in behalf of the electric companies. The committee is consulting the Chicago ordinance for particulars.

A $400,000 mortgage has been placed on the light and street railway plant and other property of the Winona General Electric company. The mortgage is given to the Old Colony Trust company of Boston. Of the bonds thus secured $100,000 will pay bonds previously issued on the street car plant. One hundred and thirty thousand dollars will be held for extensions and additions to be decided later and $170,000 will be certified and delivered. The company now has apparently all the electric business of Winona in its hands.

Electrical Inspector Deming of Minneapolis in his report for the first quarter of the year figures that there were six "electric" fires during that period, involving a total loss of $1,774.45.

Articles incorporating the Montana Electric company have been filed at Butte, Mont. The capital is $50,000 and the incorporators are John O'Rourke, George T. Schmelzel, Seth B. Smith, W. T. Jackson, V. E. Poissant and C. L. Smith. A general electrical business is contemplated. The new company is a consolidation of two companies previously operating.

Thomas Lowry has increased the wages of a thousand employes of the Twin City Rapid Transit company. It is just announced that the wages of conductors and motormen who have been in the company's employ a year or more will be increased from 17 to 20 cents per hour. Those who have been employed less than a year will get 18 instead of 17 cents. Three years ago the men were all getting 15 cents an hour, and the advance has been voluntarily made.

The St. Paul aldermen have arranged an amended street railway ordinance which it is hoped will go through. It does away with transfers on interurban trips and so may pass muster with the company.

In the case of Dr. S.O. Francis against the Western Union Telegraph company for $4,000 damages on account of a delayed message a verdict for $760 has been returned. Judge Willis held that there could be recovery for mental anguish.

It is reported that negotiations are about closed for the sale of the West Duluth Light & Water company's lighting plant to the Hartman General Electric company of Duluth. N. L. P.

PERSONAL.

Morris M. Meade, city electrician of Pittsburg, Pa., was in Chicago for several days last week.

General Manager P. G. Fiedler, of the Boston Braid Manufacturing company of Boston, was a visitor at the New York office of the WESTERN ELECTRICIAN last week.

James McKearney, formerly electrician at the Southern Hotel, St. Louis, has resigned to accept a position with the Knapp, Selmes, Chandler company of St. Louis. Ernest Arnold has been appointed his successor at the Southern.

F. G. Beach, general superintendent of the Central Union Telephone company, Chicago, has been promoted to the office of general manager of the company. Mr. Beach will make his headquarters at room 1306 Ashland block, Chicago.

D. B. Dean, who has been connected with the McGuire Manufacturing company, Chicago, for the last year, has resigned to accept a position with the Terre Haute Car & Manufacturing company. Mr. Dean will represent that company in Chicago.

L. H. Rogers of Boston, who has been connected with the General Electric company, has been appointed assistant general manager of the Brush Electric company. He has moved his wife and family to Cleveland and will reside there. Mr. Rogers some years ago was connected with the New York office of the Brush company.

Charles N. Black has been appointed assistant superintendent of the Brush Electric company. He is a graduate of Princeton, where he took the regular course, and subsequently a course in electrical engineering under Prof. Brackett. After leaving Princeton three years ago he entered the Brush shops, and by his ability, his energy and good common sense has attained his present position, for which he is well fitted.

Charles W. Phipps has been appointed superintendent of the Brush Electric company in place of F. A. Scheffler, resigned. Mr. Phipps has been connected with the Brush company for a number of years. In 1879 he went to England to install the first English Brush plants. In 1880 he went to Japan and China where he spent three years superintending the construction of a large number of Brush installations. He was subsequently superintendent of construction for the eastern district of the Brush Electric company with headquarters in New York. In 1891 he went to Cleveland as assistant superintendent of the works. Mr. Phipps is a hard worker and a very able and reliable man, and thoroughly competent to fill the important position to which he has been appointed.

NEW INCORPORATIONS.

Courter Electric company, Cobleskill, N. Y.; capital stock, $15,000; manufacturing and using electricity for light, heat and power.

P. Claus Dynamo company, New York, N. Y.; capital stock, $100,000; to manufacture and sell dynamos and electrical machinery.

Delavan Electric Light & Power company, Yorkshire, N. Y.; capital stock, $5,000; to manufacture and use electricity for light, heat and power.

South Milwaukee Light & Power company, Milwaukee, Wis.; capital stock $15,000; establishing light and power plant; F. H. Brice, Milwaukee, Wis.

Universal Electric company, Portland, Me.; capital stock, $500,000; to carry on a general electric business of all kinds; Clarence Hale, Portland, Me.

Consumers' Gas & Electric company of Pasadena, Cal.; capital stock, $100 000; to acquire and operate gas and electric works; T. H. Ward, Los Angeles, Cal.

Western Light & Power company, San Francisco, Cal., Los Angeles, Cal.; capital stock, $500,000; to carry on the business of electricians in every branch; Alfred Bouvier, San Francisco, Cal.

Coleman Battery company, Chicago, Ill.; capital stock, $25,000; to manufacture and deal in electric batteries and appliances, etc.; Robert Burns, 112 Randolph street, Chicago, Ill.

Hammond Cleat & Insulator company, Portland, Me.; capital stock, $100,000; to manufacture and deal in all kinds of electrical supplies and apparatus; Clarence Hale, Portland, Me.

Commercial Electrical Supply company, St. Louis, Mo.; capital stock, $15,000; manufacturing and dealing in electrical supplies; W. F. Carter, 224 Commercial building, St. Louis, Mo.

Newberry Passenger Railway company, Williamsport, Pa.; capital stock, $18,000; constructing and operating an electric railway in Williamsport, Pa.; Wm. B. Lamberton, Harrisburg, Pa.

Union Passenger Railway company, Williamsport, Pa.; capital stock, $3,000; constructing and operating an electric railway in Williamsport, Pa.; Wm. B. Lamberton, Harrisburg, Pa.

Buchanan Power & Electric company, Buchanan, Mich.; capital stock, $100,000; to produce electricity for manufacturing light, heat, etc., in Buchanan; J. G. Holmes, Buchanan, Mich.

Universal Electric company, Portland, Me.; capital stock, $500,000; to carry on the business of an electric lighting, manufacturing and power company; Clarence Hale, Portland Me.

Shereden Terrace Passenger Railway company, Pittsburg, Pa.; capital stock, $12,000; constructing and operating an electric railway in Allegheny county, Pa.; R. C. Duncan, Pittsburg, Pa.

Sterling Motor company, Chicago, Ill.; capital stock, $60,000; to manufacture and deal in all kinds of electrical apparatus and machinery; W. G. McLaughlin, 1072 Fulton street, Chicago, Ill.

Holly Wood & Grand View Passenger Railway company, Williamsport, Pa.; capital stock, $24,000; constructing and operating an electric railway in Williamsport, Pa.; J. H. Levick, Williamsport, Pa.

Mount Vernon Electric Street Railway company, Winton, Pa.; capital stock $24,000; constructing and operating an electric railway in Lackawanna county, Pa.; John R. Jones, Scranton, Pa.

Consumers' Electric & Gas company of Los Angeles, Cal.; capital stock, $1,000,000; to acquire real estate and to build works for generating steam, gas and electricity and to sell the same; T. H. Ward, Los Angeles, Cal.

Citizens' North Side Rapid Transit company, Chicago, Ill.; capital stock, $5,000,000; to construct and operate street railways, electric, elevated, cable or underground, in Chicago, Ill.; William Halleck Jones, 362 Dearborn street, Chicago, Ill.

Seattle Terminal Railway & Warehouse company, Seattle, Wash.; capital stock, $500,000; to do a general elevator, warehouse and grain dealing business, build and equip railways, electric light plants, etc.; Preston, Carr & Preston, Seattle, Wash.

Silver Creek Falls Power & Improvement company, Salem, Ore.; capital stock, $16,000; to own, run, operate, furnish, buy and sell water powers for electric lights, street railways, mills, factories, and for running and operating any other kind of machinery, etc.; N. M. Kaiser, Salem, Ore.

Consolidated Electric company, Chicago, Ill.; capital stock, $50,000; to manufacture and deal in electrical goods and appliances of every kind; to construct and operate electric light and power plants and other electrical plants; Consolidated Electric company, 115 Franklin street, Chicago, Ill.

The Dalles Electric Light, Telephone & Power company, The Dalles, Ore.; capital stock, $50,000; to buy, deal in, operate, maintain and manufacture all kinds of machinery, wires and appliances necessary for the purpose of creating or transferring power into electricity; Mays, Huntington & Wilson, The Dalles, Ore.

Texas City Improvement company, Galveston, Tex.; capital stock, $2,500,000; constructing deep water channel, connecting Gulf of Mexico with Texas City, building street railways near Texas City, mills, gins, cotton compresses, grain elevators at Texas City, navigating steam boats and vessels from Texas City to other points, constructing telegraph and telephone lines, manufacturing gas, light, heat and electric motive power, general manufacturing business and erecting hotel in Texas City; Robert G. Street, Galveston, Tex.

ELECTRIC LIGHTING.

Electric lights are being introduced at Conshohocken, Pa.

The city of Carrollton, Ill., is to have electric lights in the near future.

Lynchburg, Va., is to have an electric lighting plant. The plans are now under consideration.

One thousand eight hundred and fifty towns and cities in the United States are equipped with electric lights.

Watertown, N. Y., has voted to erect and maintain an electric power plant of its own, unless the present company will agree to furnish lights every night in the year at $72 per lamp.

A bill is before the Legislature of Pennsylvania to regulate the charges of electric light companies throughout the state. It provides that no company shall charge a city, town, borough or township more than 25 cents per day for an arc light. The bill is the result of the controversey in Philadelphia, where the city pays 50 cents per night for arc lights.

It is interesting to note that from a few scattering arc lights in 1884 in Philadelphia, Pa., the number has been increased to 2,733 in 1892, and from nothing in the way of underground service in 1884, 80,308 feet of conduit, 369 4 miles of telegraph and telephone wires, and 21.8 miles of electric light cable have been laid by 1893. From 3,449 poles and 441 miles of overhead wires in 1884 the number has been steadily increased to 5.955 poles and 901 miles at the present time.

The Board of Public Works and Affairs of Nashville, Tenn., is advertising for bids for electric lighting. The contract to be let will be for five years, but the city retains the right to terminate it in two years. The maximum price fixed in the specifications is twenty-six cents per light for the first year, and twenty-five cents thereafter. The contract calls for 250 lights to be put up at once, and each bidder must deposit with his bid a certified check for $10,000.

ELECTRIC RAILWAYS.

The Springfield Street Railway company's plant at Springfield, Ill., has been purchased by C. K. Monary, representing Louisville capitalists. It is understood that the plant is to be considerably extended.

A petition is pending in the council of Loraine, O., for a franchise on 14 streets of the city for an electric road. Cleveland and Elyria capitalists are asking for a franchise and contemplate building an electric road via Dover Bay Park, Lake Breeze, Randall's Road and Rock River to a connecting line with Cleveland.

The electric tramway, which has been constructed by Messrs. Siemens & Halske of Berlin in Gross-Lichterfelde, Germany, has been opened for traffic. The same firm is busily engaged upon the construction of an electric tramway at Hanover. An electric tramway is also being considered in the town of Gotha.

Electric street railway consolidation appears to have been inaugurated in Rhode Island. The absorption of the Union railway of Providence by the Narragansett Electric Light company is said to be but the beginning of a movement which is to include all electric roads in the state in one combination. The company in question has already acquired full control of the entire street car service in Providence, and in Cranston, East Providence, Manton, Elmwood and Pawtucket.

To avoid a long detour by highway the Pleasant Valley Electric Railroad company of Pittsburg has built a viaduct across Jack's Run, a small tributary of the Ohio about five miles northwest of the city. The structure carries a double-tracked electric railroad and a toll wagon road and footway. It is 740 feet long and 160 feet above the creek at its highest point. The roadway is 18 feet from curb to curb, and the two sidewalks are each five feet wide. The spans vary from 30 to 96 feet in length, and are each composed of latticed girders 3-foot deep. The floor is made of arches of terra cotta lumber, covered with concrete and asphalt. The viaduct is calculated to sustain, besides its own weight, a live load of 20 pounds per square foot over the whole of the roadway and sidewalks, the floor system to carry 12 ton electric cars, 20 feet long, with a 6 foot wheel base. It was erected by a 100 foot overhanging traveler, which started from one side and erected trestle tower, trusses and floor system in advance of itself.

TELEPHONES.

The Wisconsin Telephone company of Racine has filed articles of incorporation with a capital stock of $500 000. The company intends to operate telephone lines throughout the state with headquarters at Racine.

The telephone company is in trouble at Baltimore. Thomas E. McSberry, the agent of the company, has been arrested on a charge of receiving illegal rates for the rental of telephones, and his case will come up before the grand jury. The company is prepared to contest the validity of the Legislatures's act regulating the rates. Governor Brown will be petitioned to instruct the Attorney-general to take legal steps to force the Chesapeake Potomac Telephone company to carry out the provisions of the law enacted by the last Legislature limiting the rates charged subscribers for instruments.

MISCELLANEOUS.

The General Electrical company has absorbed the street railway and electric light plants of Winona, Minn., and the erection of a large power house will be one of the first acts of the new company.

The Marinette Gas, Electric Light & Street Railway company, of Marinette, Wis., has begun work on the extension of its plant, which will cost in the neighborhood of $25 000. A new Corliss engine and several new dynamos have been added.

A. C. Terry read an interesting paper on "Electricity Practically Applied" before the Buffalo Electrical society on the evening of March 24th. Mr. Terry's article was illustrated by the exhibition and operation of different apparatus applying directly to the advancement made in electricity for domestic use.

In the report of the meeting of the Short Electric Railway company of Cleveland, O., the announcement that William Hazleton, 3d, had been appointed the assistant general manager of the company was inadvertently omitted. Mr. Hazleton has been connected with the Short company for several years.

A Boston correspondent says that a number of Quincy capitalists are forming a stock company to place along the shores of Quincy Bay, particularly at Hough's Neck and Quincy Point, a number of electric boats for the use of pleasure and fishing parties. The intention is to use storage batteries.

The Citizens' Electric Light & Power company of Kokomo, Ind., has purchased the plant of the Kokomo Electric company, consisting of one 45, one 50 and one 35 2,000 candle power arc lamp dynamos, two 80 horse power boilers, one 150 horse power engine and accessories and the entire system of lights and wires already up. The good will and all contracts formerly owned by the Kokomo company, including the contract for lighting the city, are now the property of the Citizens' company, and it will be responsible for the fulfillment of the contracts.

TRADE NEWS.

The Riker Electric Motor company of Brooklyn, has in course of construction a 35 horse power motor to be used in connection with an exhibit at the World's Fair.

The Electric Appliance company, Chicago, has completed its assortment of "O. K." weather-proof and office wires and is now prepared to fill orders of all kinds. These wires have met with deserved success.

General Sales Agent G. J. Jackson, of the Norwich Wire company of New York, is receiving congratulations on a contract recently closed with the Bell Telephone company of Montreal, for several miles of wire for underground conduit in Toronto, Ont.

Charles Blizard, secretary of the Franklin Electric company of New York, manufacturer of the Franklin multipolar accumulator (Irving system) is in Chicago introducing these batteries, for which numerous merits and many advantageous improvements are claimed.

The Bryant Electric company of Bridgeport, Conn., manufacturer of the Bryant switch, is now nicely settled in its new factory, which occupies a three-story building. The company has placed considerable new machinery and with enlarged quarters in all departments will have double the capacity of its old works.

The Ansonia Electric company reports large sales and prosperous business among the electrical people of Montana and the Pacific Coast. Charles W. Cobb, the traveling agent for the company, met with gratifying success during the winter and placed many special orders for shield brand wire and Habirshaw rubber covered wire.

J. C. Chamberlin, general manager of the General Electric Launch company of New York, is sending out a neat pamphlet, descriptive of the many advantages of electric launches, and also giving a very interesting account of the construction of launches made by his company, with important data as to the capacity and cost.

H. M. Nichols, of the Redding Electric company of Boston, was in New York last week for a couple of days, during which time he made several large sales for the "Iona" switch, manufactured by this company. Mr. Nichols will visit Philadelphia, Baltimore, Chicago and several other large cities before his return to Boston.

F. C. Ross, manager of the New York office of the Eddy Electric Manufacturing company of Windsor, Conn., will hereafter be located in the Havemeyer building, Cortlandt, Church and Dey streets. A fine suite of offices has been fitted up and will afford largely increased facilities for conducting the business of that well-known company.

The American Down Draft Boiler company, Woburn, Mass., is now the sole manufacturer of the down draft steam boilers and smoke preventing attachments for ordinary boilers. It has fitted up a shop in Woburn, Mass., and further enlarged the capacity for business so that it is now prepared to give prompt attention to all inquiries and orders in its line.

The Sioux City Electrical Supply company has doubled its foundry capacity, adding two brass, one solder and babbitt and one zinc furnaces. The company is also working a night gang, and reports a splendid trade in electrical brass and zinc. The repair shop is also crowded, rebuilding electrical machinery, making commutators, trolley wheels and other supplies.

Queen & Co., Philadelphia, are making a special feature of their "magnetic vane" ammeters and voltmeters. They are adapted for constant switchboard use, and will render service twenty-four hours per day without disadvantage. A number of the larger manufacturing concerns use these meters for installation work, as they present great advantages in being constant, accurate, durable, and low in price. Circular No. 420, which contains full information concerning these meters, will be mailed by the makers upon application.

The trade will be interested in the illustrated catalogue and price list recently published by the Holtzer-Cabot Electric company, 92 Franklin street, Boston, Mass. The book is quite exhaustive and describes fully the company's line of dynamos, indicators, controllers, switches, etc. Full explanations are contained for special wiring and locating for motors and dynamos. A special feature is made of the company's line of fan motors which is particularly complete and worthy of attention.

The Helios Electric company of Philadelphia has added a large amount of new machinery to facilitate the filling of its orders, but appreciating that it will soon outgrow the present quarters, the company has leased a large factory building at Germantown Junction, a few miles from Philadelphia, where it will move its offices and works July 1st. The new quarters will be filled with new machinery, which will give a capacity of fifty lamps daily. The building is 50 by 225 feet and three stories high. Much credit is due General Manager D. C. Spruance for the energetic manner in which he has pushed this company to the front. He returned last week from an extended trip through the West and South much pleased with the numerous orders he has secured.

The Onondaga Dynamo company of Syracuse, N. Y., has received a very flattering testimonial from E. C. Stearns & Co., manufacturers of hardware specialities. The latter concern was induced some time ago to investigate the merits of the Onondaga company's machines, comparing them with the makes of older companies. As a result of his investigation Stearns & Co. placed an order for one 500 light machine. This gave satisfaction and a second order was given for an auxiliary dynamo of 50 lights capacity and subsequently they substituted one of the plating dynamos of the Onondaga company for another make in their nickel room. All these machines are giving satisfaction, ranging in capacity from 15 to 20 per cent. better than the manufacturers rate them.

BUSINESS.

The Central Electric company, Chicago, is kept busy filling orders. The business in Okonite wire, conduit and general supplies was never so great, and the company's large capacity for taking care of its customers is being tested to the utmost at this time. The new socket recently launched on the market by this company is meeting with favorable results. The company is making a specialty of porcelain branch blocks, cut-outs, etc., and is having an unusual demand. The pin and bracket factory of this company is running night and day, and can scarcely keep up with the demand.

H. Hubbell, manufacturer of machinery and tools, Bridgeport, Conn., has recently enlarged his business in manufacturing horizontal bench tapping machines, but will dispense with the tool part of the works. Of this tapping machine, it may be said that the spindle is driven by two 2-inch belts, running in reverse directions, giving a speed of 1,200 to 1,500 per minute. The reversing of the tap is accomplished by light foot pressure on a treadle, through the means of a lever that actuates a friction cone, covered with a moulded leather surface. For tapping small work the machine is provided with a rest and spindle, fitted to line up with the main spindle, on the end of which gigs or holders may be attached to accommodate various shaped pieces. The spindle is provided with a knurled collar that is grasped by the operator in the process of tapping. If from any cause the tap should be run too far in, or become caught in the work, this collar may be released and allowed to revolve, with the tap and work attached, without danger of breaking the tap or injuring the operator.

F. G. Fuller, formerly with the United States Wire & Cable company, has joined the forces of the Washburn & Moen Manufacturing company, and will give his attention to the insulated wire and cable department. Mr. Fuller is now in Chicago and will remain here until after the opening of the World's Fair. Mr. Fuller will make a specialty of pushing the salamander wire which his company is manufacturing. This wire has Para rubber insulation, is fireproof and is specially designed for inside wiring in damp places. It has been submitted to many severe tests and has in every case given satisfaction. One of these made for the information of insurance inspectors was conducted in the following manner: Several smooth sample boards were prepared, each having arranged upon it samples of various well known electric wires, one sample upon each board being the salamander wire. All samples upon the boards had the same size conductor, and were carefully wired together into a circuit, the plan being to test them in comparison, and under the same conditions. These sample boards represented sixteen leading makes of insulated wires, several of them being claimed by their makers to be fireproof. Current was applied and maintained until the conductor was first brought to a red heat, then a white heat, and in some cases, melted. Under this intense heat, every one of these samples except the salamander was wholly destroyed, in several instances setting fire to the board and blazing all around the salamander, but in no case did sufficient heat escape through the salamander covering to discolor the board beneath it.

ELECTRICAL PATENTS.

Issued April 4, 1893.

494,562. Telautograph. Elisha Gray, Highland Park, Ill.

494,565. Controlling Switch for Electric Motors. Warren S. Hill, Boston, Mass.

494,585. Means for Electrically Heating Crucibles. Willis Mitchell, Malden, Mass.

The crucible consists of two insulated parts made of electrical conducting material which are supported in a frame provided with a handle, the frame carrying a pair of contact plates which make contact with the two insulated portions, whereby the contents of the crucible may be heated by the passage of a current from one of the insulated parts to the other through the molten mass.

494,586. Apparatus for Electrically Heating Crucibles. Willis Mitchell, Malden, Mass.

494,587. Electric Coal Mining Machinery. Edmund C. Morgan, Chicago, Ill.

A small motor carries upon one end of its armature shaft a cam which engages with a roller secured to the reciprocating frame carrying the tool, so that the tool may be drawn back by the cam; a spiral spring is put under tension by this act, and upon the release of the roller by the cam acts to impart to the tool a forward stroke

494,596. Police Patrol System. John H. Ring, Lowell, Mass.

494,608. Means for Switching Generators or Motors in or Out of Circuit. Nathan Van Denburgh and Frederick H. Loveridge, Chicago, Ill.

494,610. Electric Switch. George W. Webb, Wilkesharre, Pa.

494,629. Commutator Brush for Dynamos. David W. Dunn, Pittsburg, Pa.

The commutator brush is composed of pulverized carbon and silicate of soda, having sheets of copper gauze interposed between the layers thereof.

494,657. Electric Meter. Milton E. Thompson, Boston, Mass.

The meter is particularly designed for measuring alternating currents, and comprises an armature consisting of a hollow closed conductor of copper or other non-magnetic conducting material, and series coils through which passes the current to be measured, arranged with their common axis at right angles to the common axis of shunt coils, which latter coils are connected as a shunt across the circuit leading to the translating devices. These combined parts constitute an electric motor which develops a torque proportional to the energy passing through the motor.

494,667. Method of Producing Coated Metal Articles. Francis J. Clamer, Philadelphia, Pa.

494,668. Method of Coating Metal Articles. Francis J. Clamer, Philadelphia, Pa.

494,705. Electric Locomotive Regulation. Rudolph M. Hunter, Philadelphia, Pa.

By this method of regulation rheostats for varying the strength of the current and commutated fields for varying the strength of the magnetic field are dispensed with, the regulation being accomplished by varying the counter electromotive force of the motors to permit the passage of the requisite amount of current to produce the proper speed. Two motors are preferably used whose counter electromotive forces may be added or otherwise disposed of to produce the required results. Thus, when the car is starting from rest and a large current is required, the counter electromotive force is reduced to that of one motor, thereby permitting the necessary large flow of current. As the speed increases the counter electromotive force increases, and reduces the current passing through the motors. Thus, within certain speeds, the regulation is automatic, but when the speed reaches that allowable in the streets, the counter electromotive forces of the motors are added, thus opposing the current to such an extent that the required current to maintain the normal speed on the level passes through the motors.

494,710. Telegraph Pole. James W. Carver and Chester E. Carver, Pawlet, Vt.

494,721. Electric Railway Trolley. Edward Martyn, Detroit, Mich.

494,739. Brush Supporter for Dynamo-electric Machines. Axel Ekstroem, Lynn, Mass.

494,750. Switch for Electrical Currents. Henry P. Ball, Schenectady, N. Y.

494,762. Electrical Annunciator. John B. Rogers, Washington, D. C.

494,778. Coin-operated Phonograph. Ellsworth E. Flora, Chicago, Ill.

494,779. Apparatus for Boring Wells. Fulton Gardner, Chicago, Ill.

494,781. Circuit Controller for Electric Motors. Warren S. Hill, Hyde Park, Chicago, Ill.

494,786. Automatic Cut-out for Electric Signaling Boxes. Jacob F. Mehren, Chicago, Ill.

494,787. Automatic Cut-out for Electric Signaling Mechanisms. Jacob F. Mehren, Chicago, Ill.

494,807. Coin-operated Phonograph. Ellsworth E. Flora, Chicago, Ill.

494,827. Voltaic Cell. Edward Weston, Newark, N. J.

The density of the cell, and consequently the electromotive force, is practically independent of temperature changes, a standard cell being thus provided whose electromotive force is always a constant quantity. In the preferred form a saturated solution of cadmium salt in water is used as an electrolyte, and as electrodes an amalgam of cadmium and mercury opposed to an electrode of pure mercury and proto-sulphate of mercury is used. The claim reads: "A voltaic cell, the electromotive force of which is practically independent of temperature changes."

494,828. Electrical Measuring Instrument. Edward Weston, Newark, N. J.

The instrument is of the type in which the strength of an electric current is measured by the expansion of a fine wire, the object of the invention being to reduce the length of the wire from twelve feet or thereabouts to about ten inches. The wire is rigidly secured at one end, the other end being secured to the index after passing around a series of rollers, the wire being thus arranged in an open loop.

494,829. Recording Voltmeter. Edward Weston, Newark, N. J.

The principle of the invention consists in causing a contact arm moving over an elongated body traversed by a current which undergoes thereby a definite fall in voltage, automatically to cut out or introduce into the circuit such fraction of the length of the body as will compensate for the change of voltage occurring in the circuit

494,830. Ground Detector for Electric Circuits. Edward Weston, Newark, N. J.

494,832. Electric Clock. Herman Wubbeler, Beaver Falls, Pa.

494,836. Dynamo-electric Machine. Arthur S. Baxendale, Selangor, Eng.

494,849. Separator for Battery Elements. Chaimsonovitz P. Elieson, New York, N. Y.

494,852. Galvanic Battery. Derrick H. Fitch. Cazenovia, N. Y.

494,856. Electric Generator or Motor. Walter T. Goolden and Llewelyn B. Atkinson, London, Eng.

494,871. Trolley Pole Catcher. Edward L. Langheinz, Brooklyn, N. Y.

494,961. Electrical Measuring Instrument. Adolf Koepoel, Berlin, Germany.

494,964. Galvanometer. Edwin F. Northrup, Ardmore, Ohio.

In this galvanometer all external adjusting magnets are dispensed with, and in place thereof means are provided for adjusting the strength of the moving magnetic field of the system. This is effected by short circuiting, more or less, the magnetic lines of force emanating from the poles of the magnets in the moving system, leaving the system entirely independent of all external magnetic fields other than that of the earth.

494,966. Circuit Closing Clock. Herbert S. Page, Medford, assignor to Edmund D. Spear, Boston, Mass.

494,978. Electric Motor. Francis B. Crocker and Schuyler S. Wheeler, New York, N. Y.

An electric motor carrying a fan upon the end of its armature shaft is supported upon a vertical journal at an angle so that the line of thrust of the fan lies to one side of the vertical pivot, thus causing the motor and fan to revolve around the vertical axis.

494,995. Cut-out for Brush Lamps. Benjamin Adair and Charles H. Klewer, Denver, Colo.

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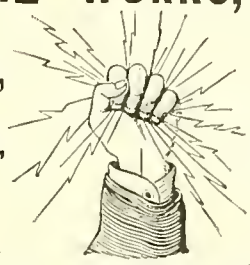

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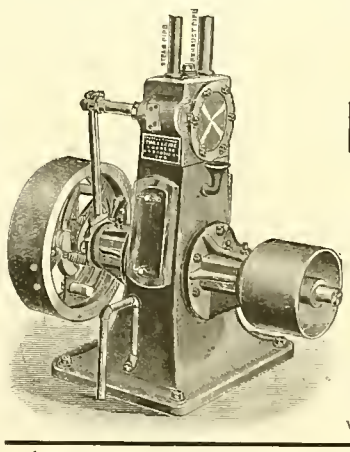

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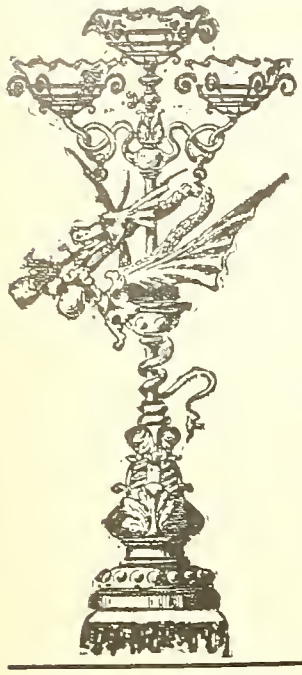

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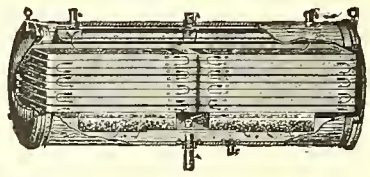

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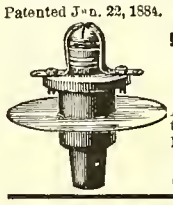

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At Milwaukee, Wisconsin.

Notice is hereby given that in pursuance of an order of the Circuit Court of Milwaukee County, Wisconsin, I will, on the 30th day of June A. D. 1893, at eleven o'clock in the forenoon of said day, at the south door of the Court House in the city and county of Milwaukee, Wisconsin, offer for sale and sell at public auction as an entirety, the street railway of the Milwaukee Electric Railway Company in said city of Milwaukee, with all the franchises and rights and privileges of said railway company for the operation and maintenance of the same, and all the property of said corporation used in or in connection with, or essential to the exercise of its said franchises.

Said railway property and franchises consist of about 6½ miles of double track, being about 13 miles of single track, in said city of Milwaukee, with all the poles, wires, cables, trucks, ties, stringers, fixtures and appliances composing or used in connection with said tracks or said railway, with franchises, privileges and rights derived from ordinances of the common council of the city of Milwaukee to maintain and operate said road; also sundry parcels of real estate in said city, with car barns and power house thereon; also the engines, boilers, machinery and rolling stock and supplies of said road.

The terms of such sale are cash.

The said street railway will be sold free of all liens and encumbrances except judgments of foreclosure and sales aggregating $21,193.-56, with interest from the 22d day of November, 1892, at 7 per cent. on $1,259.60 thereof, and at 6 per cent. per annum on the remainder. Said judgments of foreclosure covering the said specific parcels of real estate.

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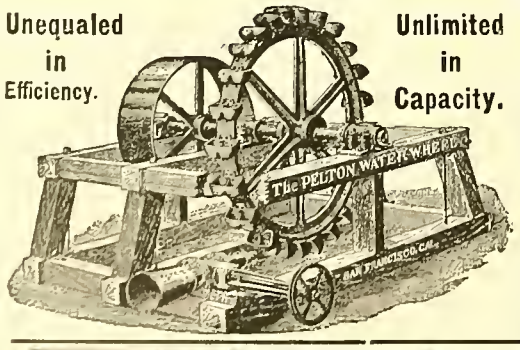

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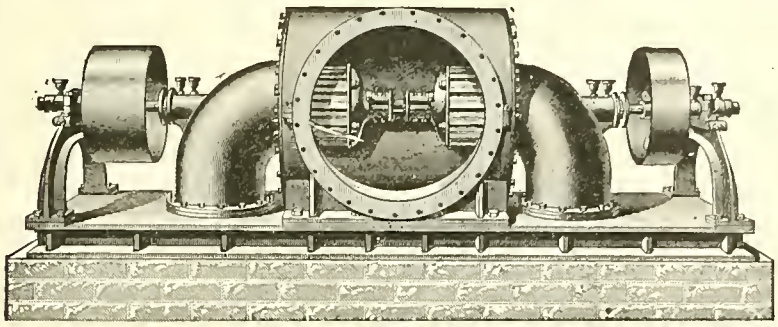

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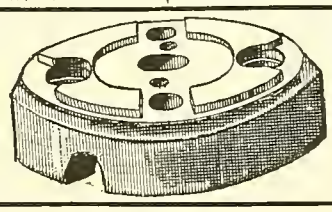

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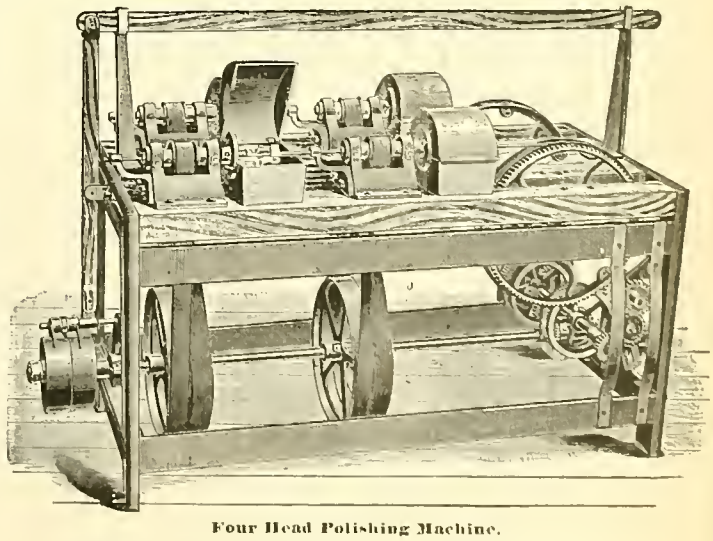

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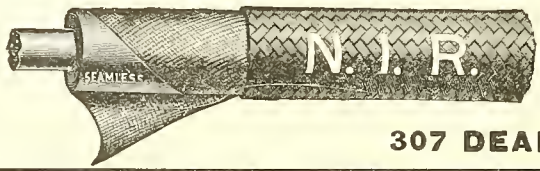

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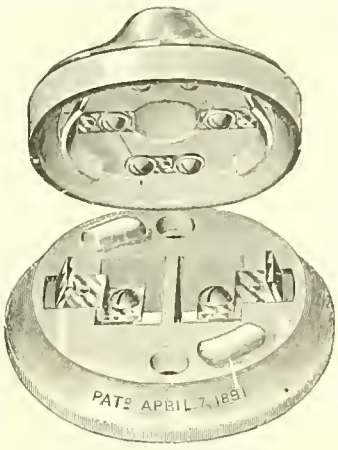

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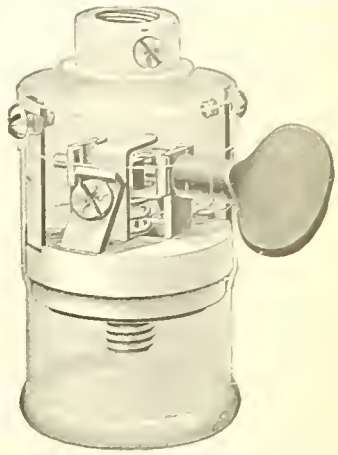

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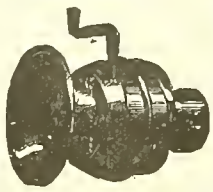

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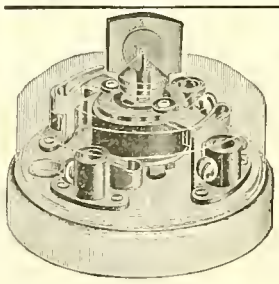

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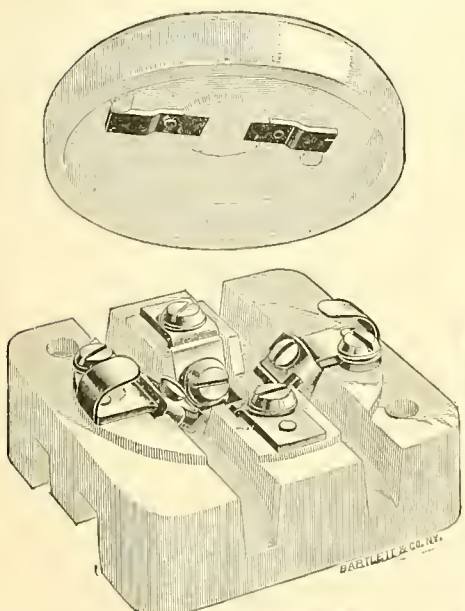

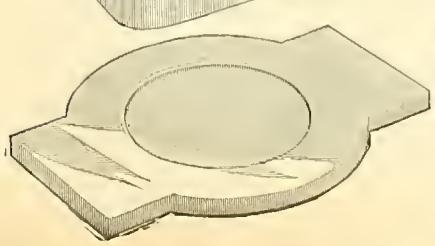

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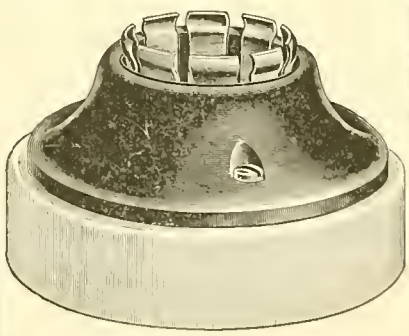

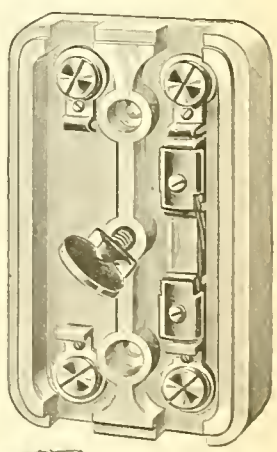

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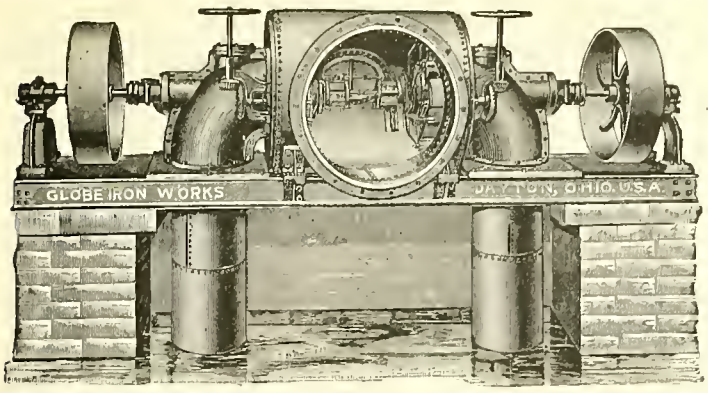

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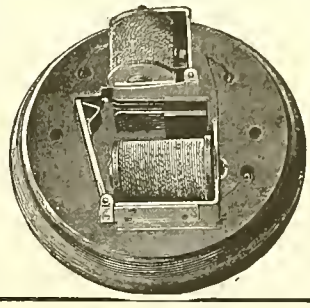

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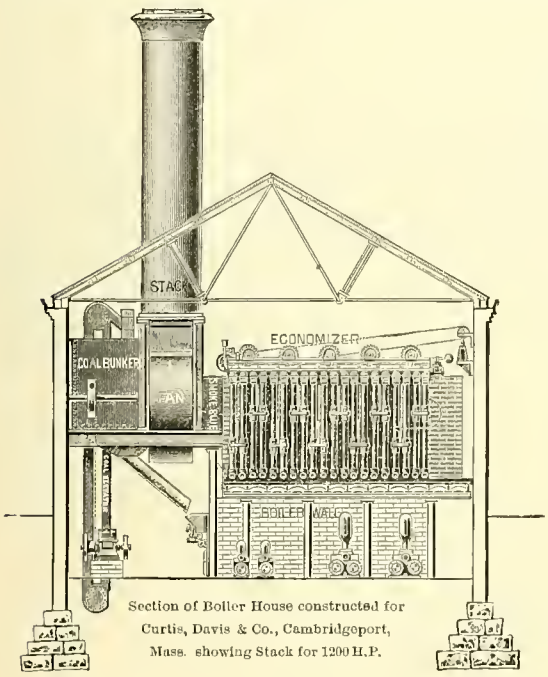

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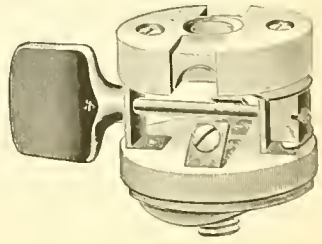

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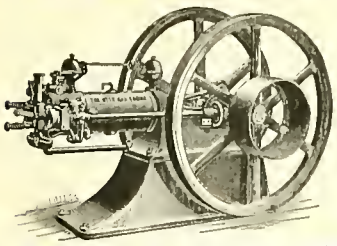

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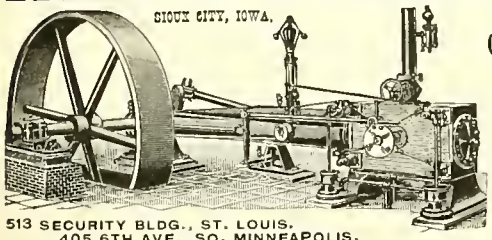
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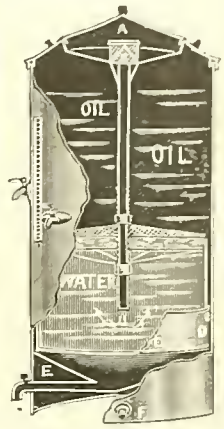

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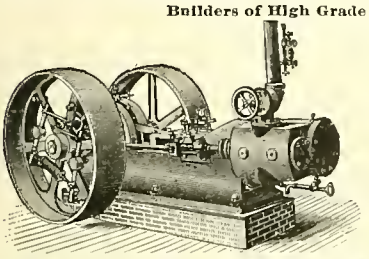
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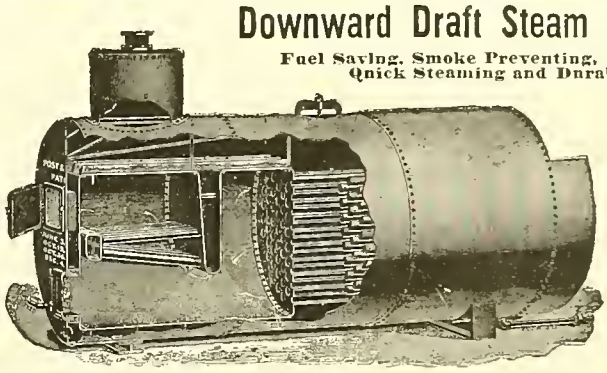
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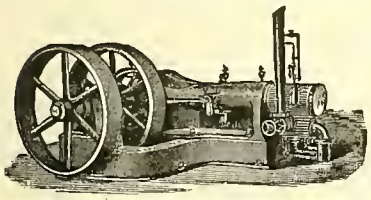
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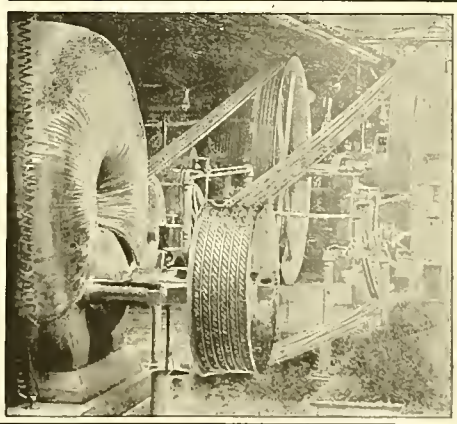
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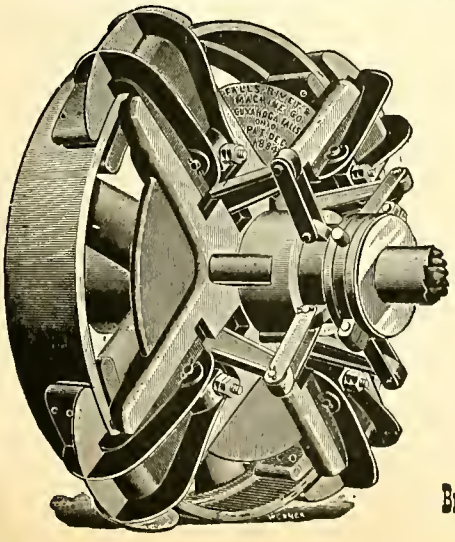
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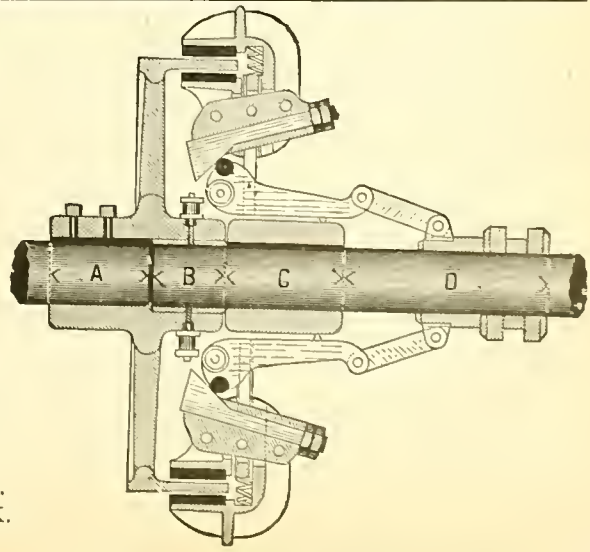

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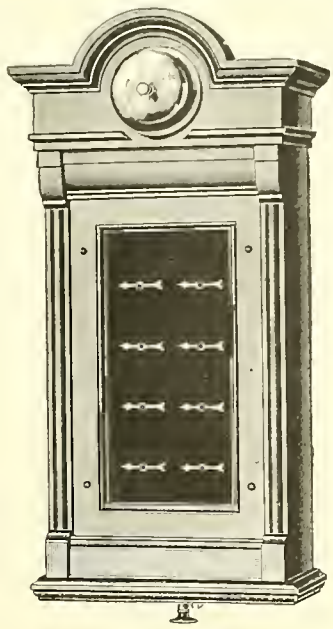

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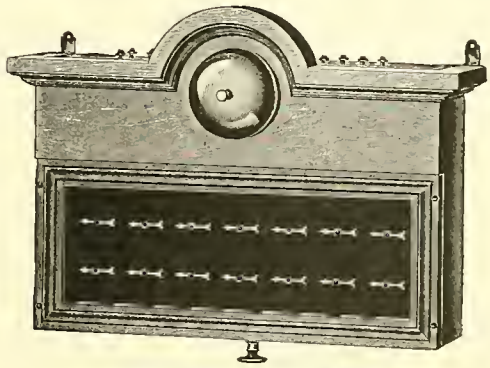

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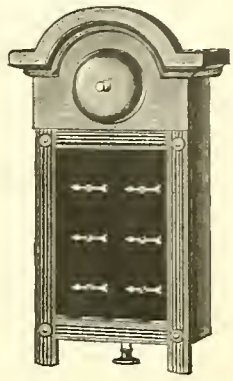

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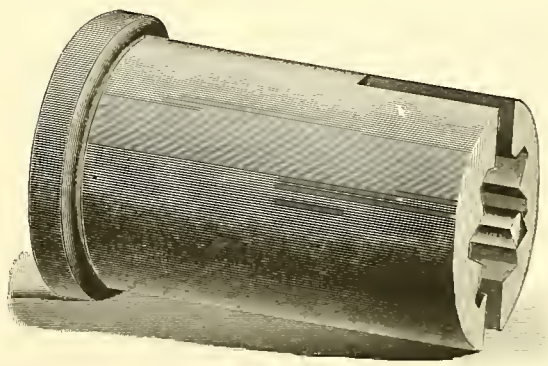

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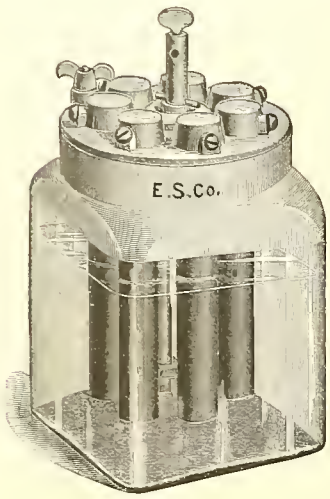

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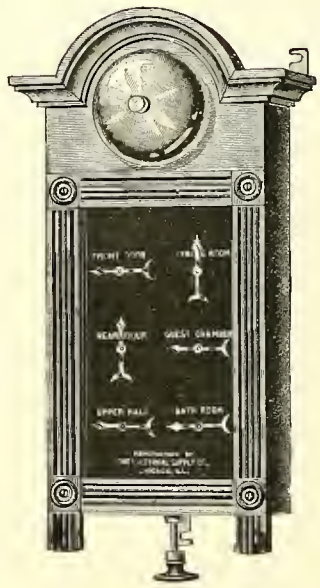
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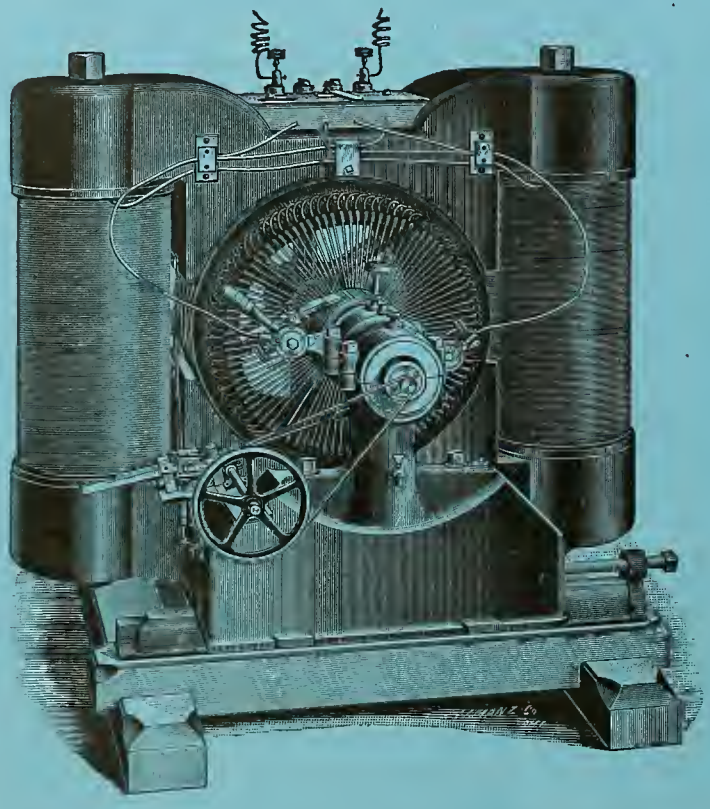

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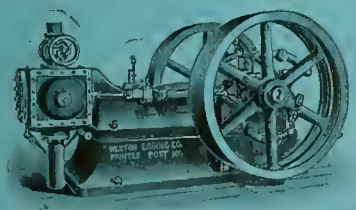

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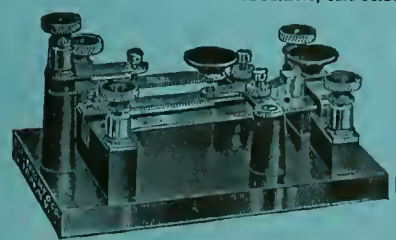

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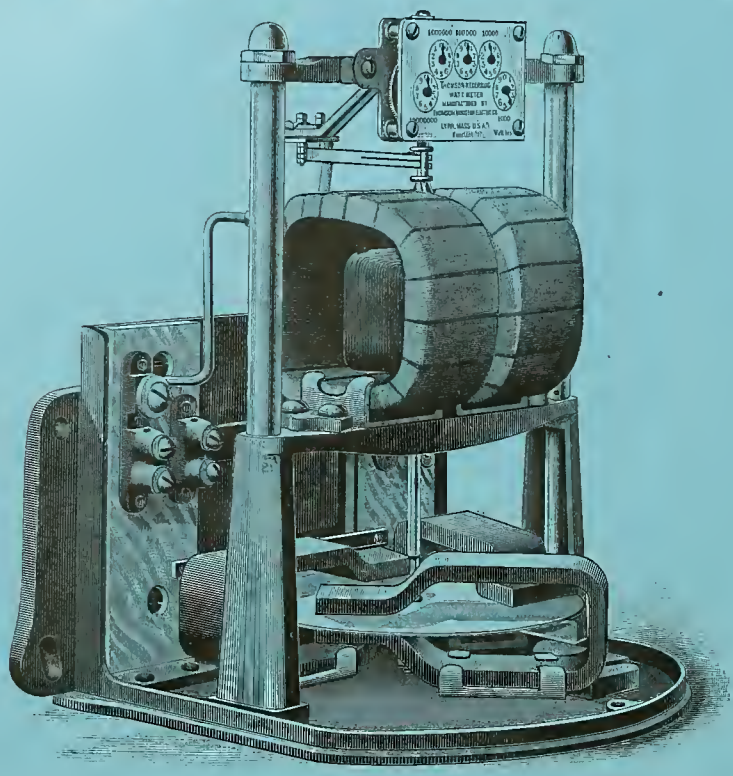

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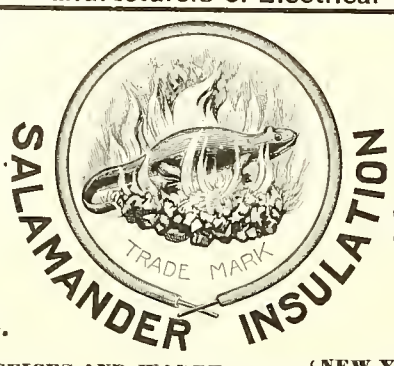

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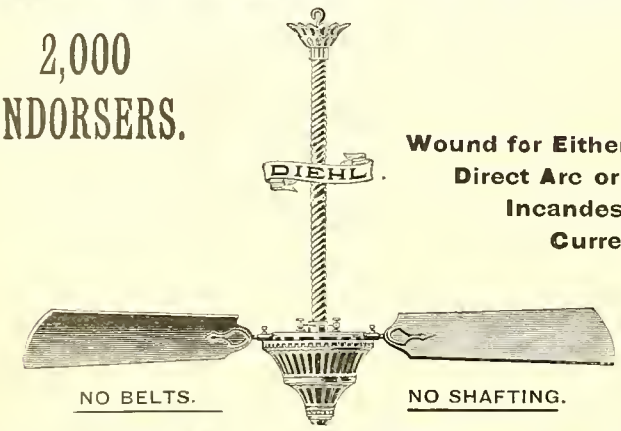

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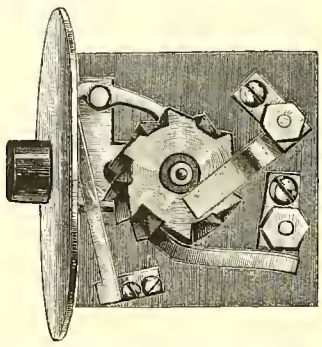

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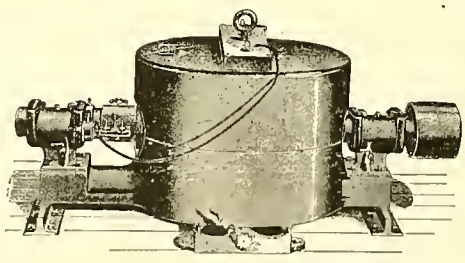

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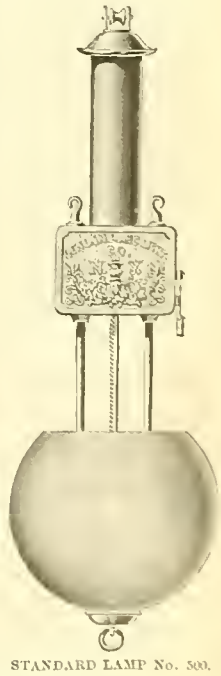

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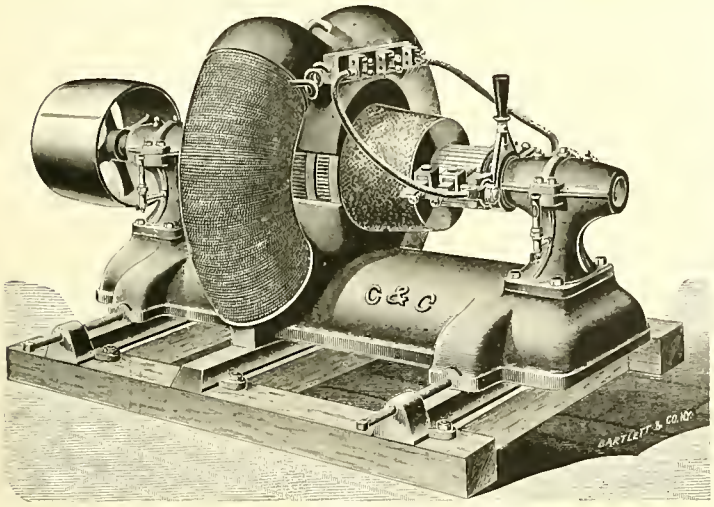

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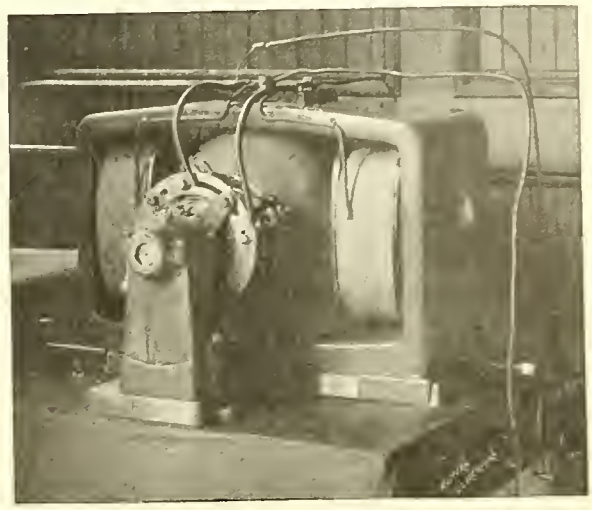

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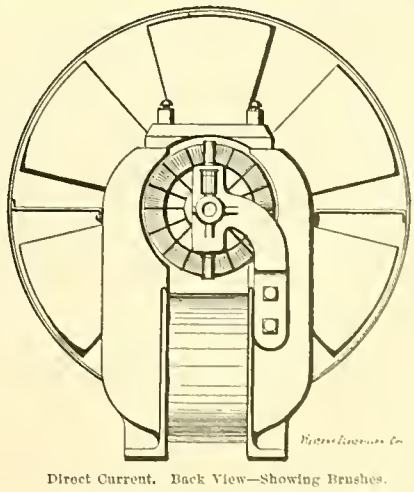

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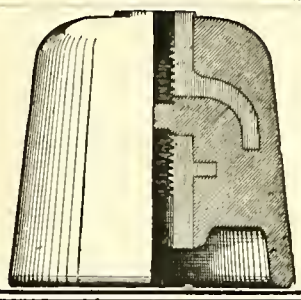

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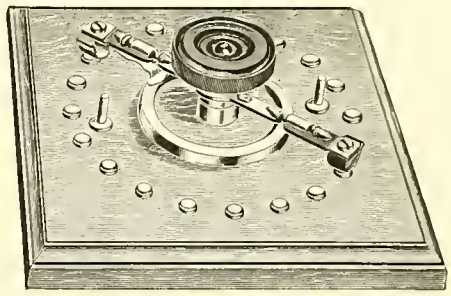

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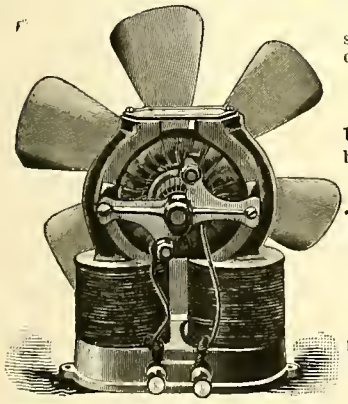

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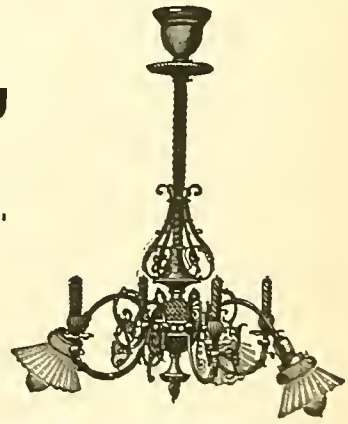

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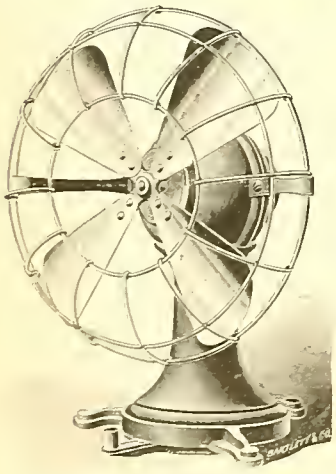

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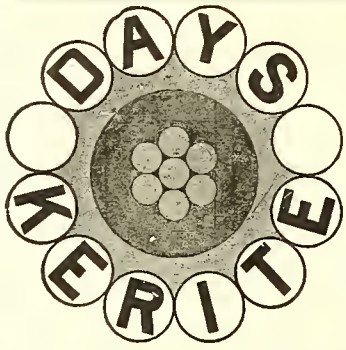

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January 27, 1893.

To the Electrical Trade:

I have this day assigned the entire interest in the Cleveland Switch, Patent No. 391,512, to THE BRYANT ELECTRIC COMPANY, of Bridgeport, Conn., together with the tools, patterns and moulds for making the Switches and Arc Cut-outs formerly manufactured and sold by THE FOREST CITY ELECTRIC WORKS, of Cleveland (Factory, Geneva, Ohio).

I trust that my former friends and patrons will extend to them the same good will and patronage that they have shown me in the past.

Very respectfully, (Signed) W. B. CLEVELAND.

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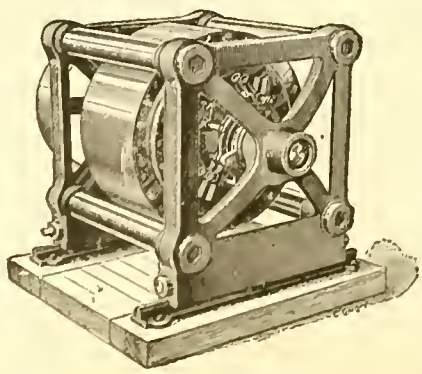

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Western Electrician.

EVERY SATURDAY.

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Electricity at the World's Fair.

Nearly all of the exhibitors in the electricity building are now busily at work arranging their displays. The Edison "tower of light" in the center of the ground floor is now about ready for the staff, and will be completed in two weeks. The other exhibits of the General Electric company are well under way, and the work is being systematically and rapidly advanced under the efficient direction of Lieut. E. J. Spencer, who has entire charge of the varied interests of this great company.

Several of the General Electric company's exhibits are illustrated in this number. Fig. 1 shows an electric locomotive designed for high speed passenger service, which will be seen in operation on the tracks of the transportation annex. The weight of the locomotive is supported by four driving wheels driven by two flexibly supported water-proof Thomson-Houston motors, supplied with current by means of an overhead trolley. It is equipped with the latest form of series parallel controller, electric air brakes, whistle and automatic safety devices, and was built with the idea of meeting all the requirements of high speed elevated railway passenger service. When it was first proposed to exhibit this locomotive at the World's Fair it was suggested that it be utilized on the elevated electric railroad, but it was discovered that it was too heavy for the structure. However, the locomotive is equally well adapted for surface work, as has been proved by its use on the Boston and Maine railroad, where it has been in service for summer passenger traffic between Lynn and a seashore resort, four miles away. The locomotive weighs about thirty tons, and is designed for a maximum speed of fifty miles an hour.

The graceful arc lamp post shown in Fig. 2 was imported from Europe by the General Electric company purposely for erection on the World's Fair grounds. The pole is of iron, much of the surface covered with beautiful designs wrought in relief, and is 42 feet high. It sustains four Thomson-Houston lamps of 2,000 nominal candle power each. The post was originally erected in Turin, Italy, by the Thomson-Houston International Electric company, and is known as the "Turin jubilee pole." It will be seen at the exposition in the space between the administration building and the terminal railway station. Five other types of foreign decorated posts, ordered by the General Electric company for exhibition at the World's Fair, are shown in Fig. 3. All were erected by the Thomson-Houston International company. Poles *A* and *C* are German, and were designed at the Hamburg office of the company; *B* comes from Bilboa, Spain; *D* from Milan, Italy, and *E* from Paris. These will be shown in the electricity building.

Fig. 4 shows a five ton electric derrick that the General company will show, and Fig. 5 represents the base of the apparatus, showing motor and hoist. The platform upon which the mechanism stands is only 6½ by 7 feet, and the entire apparatus can be controlled by one man.

Among the pavilions thus far erected in the gallery of the electricity building are those of the Commercial Cable company, Roessler-Hasslacher Chemical company, Day's Kerite company, Chicago Electric Wire company, Norwich Insulated Wire company, Ansonia Electric company and Leclanche Battery company. In the German gallery display the following named firms, mostly instrument makers, will make exhibits: Voigtlaender & Son, Brunswick; Franz Schmidt & Haensch, Berlin; C. A. Steinheil's Sons, Munich; Emil Sydow, Berlin; Doeriffel & Faerber, Berlin; Steeg & Reuter, Homburg; Max Kohl, Chemnitz; Schott & Gen, Jena; L. Tesdorpf, Stuttgart; Clemens Riefler, Munich; Paul Bunge, Hamburg; Georg Butenschoen, Hamburg; Albert Ott, Kempten; Paul Gebhardt, Berlin; C. F. Betting, Cassel, Julius Elsner, Goldlauter.

The New York, Boston and Philadelphia circuits of the Long Distance Telephone company have been connected with the World's Fair exchange. Manager A. H. Elmore of the latter sent greetings over the wires to Manager Hovey at the New York office and received congratulations from him. Connections have been made at New York with telephones in other eastern cities. This has been arranged to continue during the exposition, so that at any

FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.

time visitors can converse by telephone with relatives, friends or business partners in the cities of the New England and Middle States.

A trial trip of a train on the elevated electric railway at the World's Fair was made on Saturday of last week. A regular train consisting of a motor car and three trailers, with a capacity for 400 passengers, was made up, and several journeys were made around the southern loop. Power was furnished by the Greene 750 horse power engine and General Electric 500 kilowatt generator illustrated in last week's WESTERN ELECTRICIAN. It had been intended to make a run over the entire track, but this was prevented by the fact that the loop station was found to project four inches over the space required for the train, which, of course, prevented farther progress. It was also discovered that a slight improvement was necessary in the device for raising the trolley shoe at switches. As far as the operation of the train itself was concerned, however, everything worked admirably. The motors, with their capacity of over 500 horse power, responded easily to every demand made upon them, and were under complete regulation. The air brakes controlled the cars with ease, and the train was stopped within its own length when going at full speed. In the power station there were no hitches, the big engine and generator taking care of the load thrown upon them without effort. In a few days the changes found necessary in the track construction will be completed, and then the entire circuit of the line will be made. Among those who rode in the cars on Saturday were W. E. Baker, general manager of the road; E. C. Ward, secretary; C. P. Matlack, chief engineer; C. H. Macloskie, electrical engineer; B. J. Arnold, consulting engineer: E. W. Rice, Jr., superintendent of the General Electric Works at Lynn; John Kruesi, superintendent of the General Electric Works at Schenectady; W. H. Knight, superintendent of railway construction at Lynn; F. W. Horne and a number of Chicago newspaper men.

The work of raising the five great arc light coronas for the manufactures building, described in the WESTERN ELECTRICIAN of February 18th, was begun last week, and has attracted much attention. The center electrolier weighs 12 tons and each of the others nine tons. A large force of men, with a complicated system of blocks and tackles, is employed on the work.

The annual report of President Higinbotham for the year ending April 1, 1893, contains a few items of especial interest to the electrical fraternity. Among the miscellaneous receipts, for instance, is one item of $350 for electric lighting and another of $6,419.85 for electric power furnished, while "power and light in suspense" is put down as contributing $7,761. Under the head of general expenses, electric lights and appliances are shown to have cost $54,173.14, telegrams and cablegrams $4,252.45 and telephones $7,936.14. Charged to construction expenses are: Boiler house, $32,908.53; boiler plant, $71,813.09; electrical engineering, $55,793.93; electricity building, $434,123.58; electric plant, $432,736.88; mechanical engineering, $38,809.01; office building for mechanical and electrical department, $10,373.01; police signal boxes, $10,725.59; power plant, machinery hall, $216,100.53. Of the total expenditures of $16,708,826.48 by far the largest amount, $14,043,134.58, went for construction. Aside from its share of this sum the electricity department is charged with $22,813.61. It is interesting to note that on March 31st the total receipts had been $17,496,432.16, leaving a balance of $787,605.68.

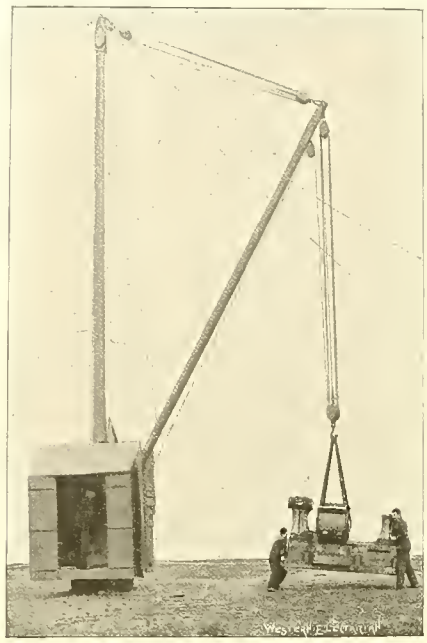


FIG. 4. ELECTRICITY AT THE WORLD'S FAIR.

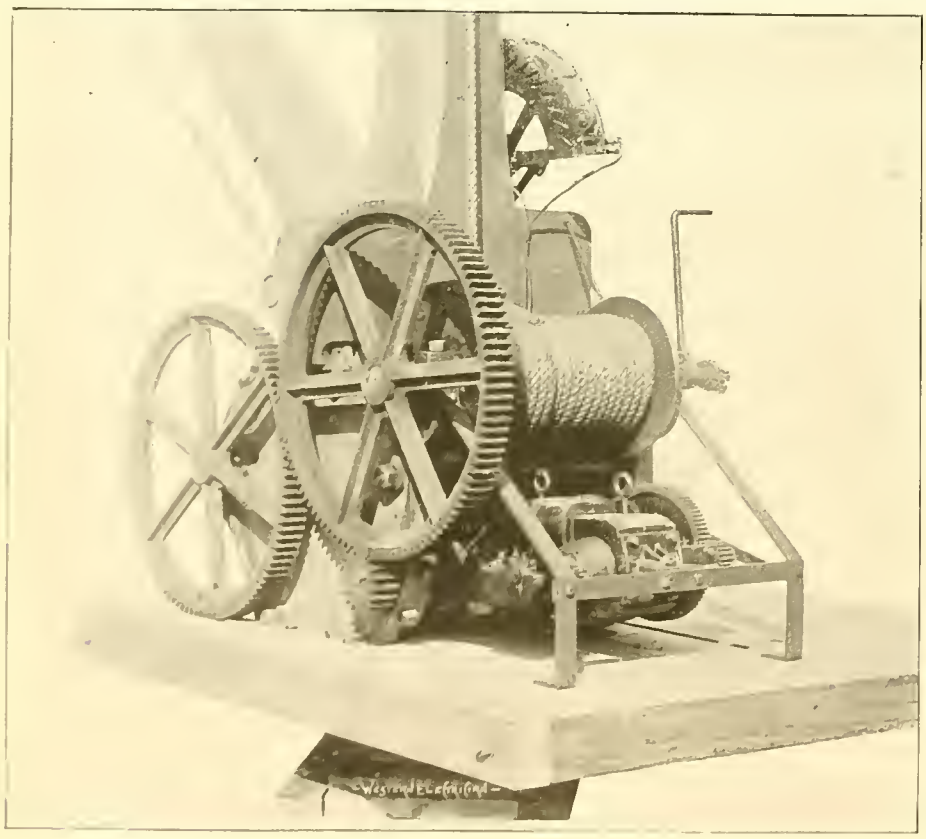


FIG. 5. ELECTRICITY AT THE WORLD'S FAIR.

Engineers will be interested in the announcement that the reception rooms and offices of the general and executive committees of the Associated Engineering Societies of the United States and Canada and of the general committee of the World's Congress Auxiliary on the International Engineering Congress, on and after May 1st, and until the close of the exposition, will be at No. 10 Van Buren street, Chicago. All communications after May 1st should be addressed to, or to the care of, Max E. Schmidt, secretary. Visiting engineers may have their mail thus addressed. The committee rooms of the Associated Societies at the exposition will be situated in the southwest corner of the gallery of the mines and mining building, where the secretary or some of the staff will be present during the exposition to meet visiting engineers.

The E. S. Greeley & Co. is preparing to make an elaborate exhibit on the floor of electricity building. Louis J. Auerbacher is now on the ground looking after this company's display.

One of the Westingbouse 4,000 light alternators has been used for several days in drying out converters. During the winter months a larger number of converters accumulated in machinery hall, and on account of the leaky condition of the roof became covered with snow and ice, which, on melting, leaked into the boxes. An ingenious manner of drying these dampened converters by electricity was advised by General Manager Keller. The secondaries of a number were wired in series with the dynamo and the primary coils short circuited. The potential of the dynamo was then raised sufficiently to send a slightly heavier current through the converters than that which would be employed if the transformers were actually in use under full load. This was kept up until the converters were thoroughly dried by the heat, and then another batch was put in circuit and the operation repeated.

The Westinghouse company expects to have nearly two thousand alternating current arc lamps on the grounds. A large number of these will be in Midway Plaisance and about 200 in the transportation annex. The lamps will be on 100 volt secondary circuits, three in series. Each lamp will take 14 amperes at 35 volts. An "economy coil" is introduced to prevent waste of current in case only one or two lamps of a series is burning.

The Westinghouse company has secured the space on the ground floor of the electricity building originally allotted to the Detroit Electrical Works, as that concern will not make an exhibit. This space is contiguous to that previously allotted to the Pittsburg company in the southern part of the building. The Westinghouse people have also secured a portion of the space originally given to France in the northern part of the building, and have now over 15,000 square feet.

The Electrical Forging company of Boston has 1,955 feet space on the first floor of the electrical building at the World's Fair. It will put in a 200 horse power heating plant driven by two 100 horse power motors. It will exhibit an electrical cooking process, and machines for rolling metals and making forgings, etc.

Thermal Storage for Central Stations.

Prof. Forbes' paper on "Thermal Storage" at the St. Louis convention of the National Electric Light association is attracting considerable attention abroad. The London *Electrical Review*, after presenting an elaborate summary of this address, says:

Prof. Forbes accepts Mr. Halpin's figures relative to the saving to be effected as compared with secondary batteries, and generally appears to make out a good case for thermal storage, where space is not an object, and there are some very excellent reasons for its adoption, some of which we have noted above, but where Prof. Forbes thinks it especially useful is in the utilization of the heat of refuse incineration. Here there should be scope for the system, for the fuel comes in almost as a gift. General refuse cannot well be burned under a steam boiler. It ought to be completely consumed in non-absorbent furnaces to render the process innocuous and inoffensive, and the heat utilized entirely outside the range of the place of combustion. Refuse destruction should be a continuous process, and the thermal storage system affords a means of saving heat which would otherwise be uselessly and wastefully dispersed. The pumping of water to a position of potential energy very rightly commends itself to Prof. Forbes as the best means of storage where there is a convenient hill, as, for example, at Edinburg; but suitable reservoirs are not always to hand. A use for refuse, however, suggests itself in a place like London, where the water supply is chiefly pumped by day, and there is left for night time the production of light. The truth is that the excessive individualism of all our undertakings is responsible for much waste. A pumping engine may not be suitable to drive dynamos, but the fuel which burns to waste in an incinerator would supply steam which would as well drive an electric engine as a pump, and the same set of boilers would supply steam for both purposes. We might, did we wish it, find means for dispensing with the necessity of thermal storage, but at present we prefer to ignore such clearly obvious advantages as are open to us by a line of less individual effort.

Speaking generally, we should say that if anyone is disposed to be carried away by the thermal storage idea, he would do well to first make a few simple calculations as to the enormous bulkiness of the storage tanks, and not to forget the high temperatures which accompany high pressures when he comes to consider the boiler proper.

The Alternating Current System in America.[1]

By G. L. Addenbrooke.

At the late St. Louis convention a paper entitled "Some Experiences with the Alternating System" was read by R. H. Sterling, and was followed by a long discussion.

In speaking of the paper, the president said: "Gentlemen, you have before you one of the most interesting papers that you are likely to have an opportunity to discuss, and I trust the discussion will be free and full."

As the paper is descriptive and non-controversive, and the discussion serves principally to elucidate it further, the two together may be taken as fairly representative of the best present methods of operating alternating current stations in America, and the views of leading practical men upon the whole subject.

On the general question I do not think I can do better than extract almost *verbatim* a portion of the speech of Prof. E. R. Weston after the paper was read, as it is well worth the attention of English readers, and not only institutes a comparison between alternating and continuous currents, but between English and American practice. It is as follows:

"The question of the distribution of energy by the two systems under discussion is receiving great attention both on this side and the other side of the Atlantic. The systems as established here differ radically in one respect, at least, from the systems established on the other side. Here, for the purpose of economy in the first cost, a very high rate of alternation has been adopted. From present experience it seems as though this was a fundamental mistake, and that the mistake will be more apparent as the system has to be forced under ground, which it will sooner or later. We must all recognize the fact that any system of aerial conductors can never give us the safe and sure service which is necessary to enable us to compete with a satisfactory and reliable source of illumination such as gas. If our alternating current systems of this country were forced under ground, the loss would be undoubtedly greatly increased, but what the losses are exactly at present I have not been able to find out. No one seems to have made any special effort to determine them, and to ascertain exactly how they are distributed. With the direct system the losses are at the lowest point, and are very small, indeed, when the load is very light. The energy consumed then is practically what you use in the lamps, but in the alternating systems there is an increase of loss in the converters, as we readily understand. The difficulty of dealing with and ascertaining what these losses are through the wires is serious indeed, and it is impossible, almost, to arrive at them from the actual running plant, because it is very difficult to ascertain the total number of lights in circuit, and how these lights are distributed. To make a test, therefore, that would be really satisfactory, to ascertain the commercial efficiency of the alternating *versus* the direct current system, involves a great deal of labor and careful thought. The constant growth of the alternating current system indicates, however, one thing surely, namely, that it is filling a long felt want, and that it is a money-making investment, at least, for a large number of people. Whether the system as it exists in this country to-day will not be radically modified in the next few years, so as to approach more closely the systems of Europe, is a question; but I think it will. I think that will undoubtedly be done, and the tendency will be toward a lower rate of alternation and greater general efficiency. If any gentleman here has made a careful determination of the energy transformed, and has compared that with the energy actually used in the lamps, it ought to be brought out. It is a matter that everybody is seeking light on."

As no one seems to have taken any exception to these views, they may, being in accordance with the rest of the paper, be considered as agreeing well with the opinions of American engineers on the subject mentioned. This speech shows as, indeed, does the paper itself, that the greater part of American alternating work is still overhead, and that the methods of working adopted are designed to meet such a state of things. Next, it points to the fact that there is even more uncertainty about alternating current measurements among practical men in America than on this side. Lastly, it pays a very handsome tribute to English and European engineering in acknowledging that in theoretical and practical perfection the systems employed by us are the better, and are worthy of imitation, a tribute to the soundness of English engineering and science particularly, which is not ungrateful; although we on our side must acknowledge that Americans have made a more extended use of the alternating system than we have. Another point worthy of notice is that neither in the paper nor discussion is the parallel running of alternators mentioned as a usual practice, or a possible one; indeed one speaker refers to the running of alternators on separate circuits as a direct advantage over the parallel method as adopted in direct current stations. That a question of such practical importance here, and which has received so much attention, should come in for so little on an occasion like this, may seem curious, unless the American present system of distribution is properly understood.

In England, with an underground service, it is of importance to have a few main circuits, and numerous branches leading from them, as it is undesirable to have many parallel but separate circuits in the same conduit or pipe. This objection does not, however, apply in America, where overhead circuits on poles are used. As the poles will carry a large number of wires or cables, which are preferably light, it is easy to run a circuit direct from the station to any particular spot at any time without interfering with existing circuits. As further circuits are only erected for immediate prospective requirements, this method of distribution naturally brings it about that then a great many main circuits of comparatively small size are started from the station, consequently the load is easily distributed with fair economy over separate dynamos. The objections, however, to the galaxy of overhead cables or wires, which this system implies if worked on a large scale, is, evidently, from the tone of the speakers at the convention, proving too much for even American susceptibilities, and therefore it is probable that it will not exist in large towns for many more years.

To work a system of this sort requires naturally an elaborate or rather extended switchboard, and Mr. Sterling devotes a good deal of his paper to a description of a typical one. In principle, it simply consists of what was known as the Edison switch board in the early days of telephony. Mr. Sterling states that the board is preferably of marble. The circuits are all attached to vertical wires or cables arranged in pairs on the front of the board. On the back of the board are similar rows of wires, but running horizontally, a pair of wires for each dynamo. At the intersecting points double pole switches are placed so that any dynamo can be connected to any circuit. It is of course unnecessary to multiply this power of cross connection beyond a certain limit if the station is large, as the dynamos and circuits can be grouped in sections.

Directions are given for placing the volt and amperemeters and fuses, but these do not differ essentially from English practice, and the remarks which follow, at some length, on fuses, are not of great moment, since English engineers have pretty well mastered the difficulties under this heading, working at 2,000 volts, whereas the standard American working pressure for the primary current is only half this. It may be said that horizontally placed fuses are found to act better and are less liable to arc than those placed vertically, a fact which we can thoroughly corroborate.

A long paragraph of Mr. Sterling's paper is devoted to lightning arresters, a subject which does not interest us so much on this side where circuits are underground, but the following on converter cut-outs and switches is much to the point: "We are learning now that it is far preferable to have no fuses in the converter case, but a large primary fuse and switch box combined, removed from the converter." We have long since discarded secondary fuses in converters.

With the large number of circuits running parallel for long distances which the American system requires, it is not surprising to find that inductive effects occur occasionally between neighboring wires when attached to different dynamos not working synchronously, and which results in the lights 'jumping.' The remedy adopted, if one of the circuits cannot be shifted on to another dynamo, appears to be to transpose the mains midway in the manner which is adopted in telephony.

The remainder of the paper and a considerable portion of the discussion are devoted to the question of maintaining the proper pressure at the lamps and to devices for effecting it. This is a subject which has not received the same attention in Europe as in America, partly because the American circuits are as a rule larger than ours and scattered over a wider area, but chiefly owing to the fact that the primary potential employed is usually only 1,000 volts in America instead of at least 2,000 as with us. These two circumstances coupled with the use of numerous separate circuits, has caused the regulating of the pressure in feeders to assume a more important and complicated aspect than it has here at present. Regarding this Mr. Wagner says in the discussion: "I suppose you refer to the average loss in distributing the current. Of course that is left largely with the engineer designing the station and the circuits. In the case of the Missouri Electric Light company it varies from 5 to 10 per cent.; the average probably is about 8 per cent.—6 per cent. in the feeders and 2 per cent. in the mains. It depends on the proportion between the average load and the maximum load. That differs at different seasons of the year."

Regulation is effected by means of the Stillwell regulator or "booster," as it is euphemistically termed. This is simply a converter, each secondary turn of which is connected with a commutator. The secondary and the commutator are put in series with the main whose pressure it is desired to raise, and by altering the commutator more or less turns of the secondary can be included in the circuit. The primary circuit is simply connected across the mains in the ordinary way. The action of this apparatus is generally referred to as satisfactory, it being usually made to raise the potential by steps from 1 to 20 volts at will. As far as I am aware, similar apparatus is so far not in use in England because not yet needed, but as I believe its working is generally known to English engineers it is unnecessary to follow the description of it further, particularly as no theoretical details are given as to its working efficiency.

Such, as set forth in this paper and the discussion, appears to be the usual American method of distributing alternating currents to-day. It is characteristic that though questions are asked, nothing is said to the point as to the relative efficiency of direct *versus* alternating currents, or how the efficiency of such an alternative station as is described works out. Our practical cousins seem still fairly satisfied with the fact that they can cover a large area of ground more easily and cheaply with an overhead alternating system than with a low pressure direct one, and that it can be made to pay. As a general body they have evidently not yet reached the point we have, though as they get more circuits underground they will do so. If, therefore, any further solution of the question of alternating

FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.

1. Abstract of paper in the London *Electrical Review*.

versus continuous current supply is to be looked for now it is to ourselves that we must turn for the solution.

Three Telegraph Bills Unfavorably Reported to the Illinois Legislature.

Three bills affecting telegraph companies have been under consideration in the Illinois Legislature during the last week. On April 12th the committee on corporations took up the subject. Bill No. 266 provides for the taxing of telegraph, telephone and express companies a certain per centage of their gross receipts; bill No. 198 compels telegraph companies to deliver all messages within one hour after their receipt; bill No. 205 requires telegraph companies to provide night operators at all offices controlled by them. Mr. Seawell, of the sub-committee to which these bills were referred, reported them back to the full committee with the recommendation that they do not pass. Mr. Nohe moved that the report of the sub-committee be received and that the bills be referred to the house with an unfavorable recommendation, but Mr. O'Connor thought that there was some merit in bill No. 198, and while it probably needed amendment he would like to see it become a law in some shape. It was then agreed that bills 205 and 266 should be reported unfavorably and that bill 198 should be considered by the full committee. Mr. Nohe moved that this bill also be reported back to the house unfavorably and explained the impossibility of framing a law to compel telegraph companies to deliver messages at all points within any specified time. The law as it now existed did not admit of any unreasonable delay in the delivery of messages and was entirely sufficient. J. B. Inman, manager, of the Western Union Telegraph company at Springfield, who was present, was called upon to give his views on the bill. He explained that if it became a law telegraph messages would have to be delivered at all hours of the night, and, therefore, night rates would be abolished. He said that the Western Union Telegraph company operated 1,501 offices in the state of Illinois, Many of these were along railroad lines and were kept open solely for the convenience of the general public. The passage of the bill would close every one of these minor offices. He claimed that the Western Union company made every effort to have all messages received by it promptly delivered, and he thought that the laws now on the statute books were ample for the protection of the public. The committee seemed to be considerably impressed with the force of Mr. Inman's views and promptly decided, by a vote of 13 to 1, to send the bill back to the house with the recommendation that it do not pass.

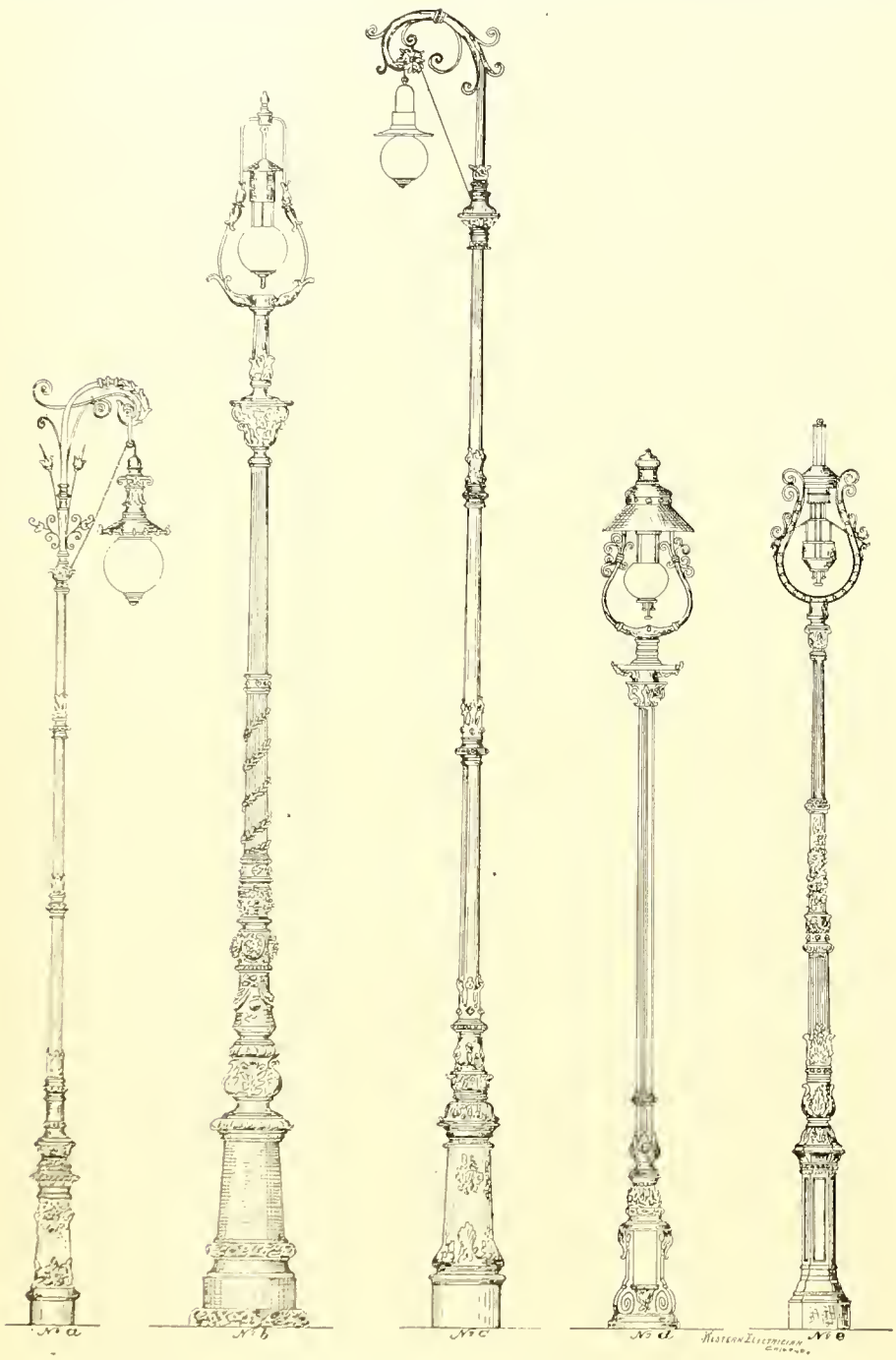


FIG. 3. ELECTRICITY AT THE WORLD'S FAIR.

American Street Railway Association.

The American Street Railway association will begin its twelfth annual meeting at Milwaukee, Wis., October 18 h. The headquarters of the association will be at the Milwaukee Industrial Exposition building, which has been secured for two weeks, although the meetings will occupy only three days. The sessions of the convention will be held in the spacious hall on the second floor, while the entire ground floor will be placed at the disposal of exhibitors The building is a very handsome structure and is admirably adapted to such exhibitions as those which have made the meetings of this association so attractive to street railway men. The building is 400 feet long and 293 feet wide, the ground floor having an area of 87,000 square feet, which can be utilized for exhibits. An advantage, which will be appreciated by those desiring power, will be found in the 150 horse power engine on the premises. The only additional charge will be the actual cost pro rata of furnishing power among the exhibitors. The nearness of Milwaukee to Chicago is considered to be a great advantage this year for making a satisfactory and extensive exhibit. The heaviest machinery and largest castings will all be under cover, and can, of course, be inspected much more advantageously than when in the street, especially should the weather be unpleasant any of the time. There is, of course, no extra charge for heating and lighting.

The secretary of the association, W. J. Richardson, announces that space will be alloted on May 10th. A charge of 10 cents per square foot will be made and no less than 100 square feet nor more than 2,000 square feet will be assigned any exhibitor without special arrangement with the secretary. Among the regulations governing exhibitors are the following:

Space allotted cannot be transferred without permision, and must be taken possession of on or before October 17th.

All goods shipped to the exposition should be plainly marked "Street Railway Exposition, Milwaukee, Wis."

The driving engine will be in operation on and after October 16th, and exhibitors of machinery in operation must have everything in running order, in readiness to start their machinery on the morning of the opening day.

All goods intended for exhibition must be on the premises and properly displayed on or before Tuesday evening, October 17th.

Exhibitors must provide all counter-shafts, pulleys, belting, hangers, etc., necessary for the transmission of power to operate their machinery.

Steam power and main shafting will be furnished to exhibitors at actual cost, to be charged for pro rata among those who use power. A main steam pipe, with numerous T's for connecting branches, will run through the hall to furnish steam to those who require it.

The main shafting will not be interferred with or taken apart, therefore exhibitors must provide themselves with split pulleys.

All machinery will, if possible, be exhibited in motion, and should be kept in operation at regular work during the hours 9 to 12 A. M., 2 to 6 P. M. and 7 to closing.

The main shafting is 3½ inches in diameter, and driven at a uniform speed of 162 revolutions per minute. The other lines of shafting are of different sizes, and all driven at a uniform speed of 200 revolutions per minute.

Exhibitors desiring to sell and deliver in the building any articles whatever must first obtain a written permit from the secretary for such consideration as may be determined upon. Any permit to sell may be revoked at any time, at the pleasure of the association.

Every possible precaution will be taken to guard against fire, and a full corps of watchmen will be on duty day and night; but the association will not be responsible for loss or damage to articles on exhibition by theft, fire or otherwise.

Thiele Lighting Bill in the Illinois Legislature.

Senator Thiele's bill providing for the extension of the powers of cities, towns and villages throughout Illinois has passed the upper house of the state Legislature, and by its terms these corporations are empowered to engage in electric lighting not only for municipal work but also for commercial service. It is generally believed that the lower house will pass the measure and in that case it is hardly to be expected that the governor will veto it. The bill is favored by many people who think that they will be able to get electric current for light and power at the bare cost of producing it. Others advocate it as a retaliatory measure believing that they are justified in ruining private enterprises on account of some imaginary grievance. The *Chicago Tribune*, which has been a persistent advocate of this measure, does not pretend that municipal plants are conducted upon an economical basis like private enterprises. Commenting upon this measure it says:

As a general rule the operating expenses of an industry run by a municipality are much higher than when a corporation or private individual has the management. Wages paid by a city are higher and more people employed than is necessary. The small economies are never thought of, but they constitute the profits in most businesses. Almost invariably, too, customers are better served by a private company than by a municipality and give it the preference.

That a city would charge consumers only cost price is an assumption. The bill does not require it. Water is not furnished at cost price, but much above it, so that there may be an income to be used for extensions. Presumptively, therefore, the city would sell electric light above cost, using the profits to extend its system and improve its plant, putting into its business the surplus which stockholders of private companies would put into their pockets.

This is in direct line with the claims that have been made by opponents of this policy. Those who favor

municipal plants claim that they are operated as economically as private enterprises, that the service is superior, and that it could be given at much lower figures than are charged by private concerns. When the bill was under discussion in the Legislature last week an amendment was offered providing for the "purchase and pay for any electric light plant or plants, including all conduits and other property used wholly or mainly as a part thereof, and all rights and interests of every kind and nature in such private plant or plants."

This amendment was offered on the ground that it would

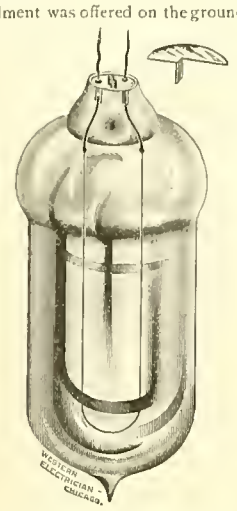


FIG. 2. VAN DER KAMMER'S INCANDESCENT LAMP.

be inequitable for the city to go in to a business in which it had allowed private capital to be invested with no intimation of future interference, and for the city to sell at cost commodities from the sale of which others expect to make a profit and thus practically to drive out of the business the private individuals engaged in it by destroying the value of their property. The argument holds good if the city is to furnish light at cost. If it is not the intention of the city to do so, the people should not be burdened by a tax for the establishment of plants from which they are to receive no material benefit, and the only object of which is to afford additional patronage for political heelers at the expense of taxpayers. This argument was presented in the Senate on Tuesday, but had no effect upon the members.

Electric Pencil in Photography.

The accompanying cut illustrates an improved form of an electric pencil used in photography. In retouching the defective lines or spots on a negative, the stroke of the pencil requires in almost every case to be minutely small, and as these small strokes have to be made with great care the process is necessarily very slow. Recently an American firm introduced a pencil which is rapidly revolved by a small electric motor so that the point of the pencil spins, and is rubbed on any spot by simply moving the point gently over it in any desired direction, thus doing away with the necessity for the tiresome confined motion of the operator's hand.

Another method and apparatus introduced in Germany consists in fixing the negative in a frame, which is vibrated rapidly by an electro magnet apparatus.

The device herewith illustrated is the invention of an Englishman and in it the pencil point is very rapidly vibrated through an exceedingly small stroke by a simple electro-magnetic contact breaker, so that the pencil has only to be guided by the operator while the electro-magnet performs the necessary rubbing at an exceedingly rapid rate, about 2,000 strokes per minute. It is claimed that this form is simpler and less liable to derangement than the rotating form.

A battery of two large Leclanche cells works this vibratory pencil, and where a number are in use one contact breaker can be arranged to work them all. Referring to the figure, *P* is the pencil pivoted at *R* in trunnions, *C* is an ebonite case carrying a bobbin of fine wire *H*, *B* is the contact breaker platinum screw point, *A* is the armature, a light piece of soft iron passing through the coil, *M* is a piece of soft iron fixed outside of the coil, to which the armature is attracted. A spring *S* opposes the attraction and sends back the armature, which is fixed on the end of the pencil. It will be readily seen that the pencil point makes a small motion compared with the play of the armature. The cut is reproduced from the London *Electrical Review*.

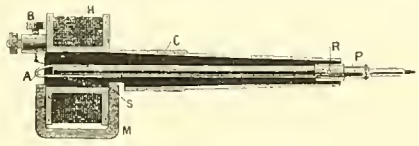
A franchise has been granted to the Wauwatosa, Wis., Street Railway company, and a line will be built through the town.

Van der Kammer's Incandescent Lamp.

Interest in the incandescent lamp litigation will be revived by the appearance on the market of the new lamp invented by John Van der Kammer of Chicago, to which attention was directed in the WESTERN ELECTRICIAN of March 25th. The characteristic features of this lamp are presented in the accompanying cuts, Fig. 1 showing the lamp complete and Fig. 2 illustrating the details of construction. The principal claims for this lamp are that by the use of the peculiar metallic base, the all-glass receiver and leading-in wire features of the Edison patent are eliminated, the process of manufacture is simplified and a more durable lamp produced. It will be noticed that the acorn shape has been adopted for this lamp, as it is particularly suitable for the form of construction employing a metallic base. In this form the metallic base is composed of two small plates of platinum, one of which is shown in the upper right hand corner of Fig. 2. These are secured in the lamp by sealing the glass around the edges. This arrangement makes the base consist of two distinct pieces of platinum, thoroughly insulated from each other. The filament of the lamp is connected to the small strips forming a part of the base and projecting into the lamp, while the wires passing through the socket are soldered to the outer side of the pieces of platinum forming the base.

The difference in expansion between the metal base and the glass globe is of no consequence in a lamp constructed in this manner, it is claimed, as there is sufficient flexibility in the metal to permit it to accommodate itself to the expansion of the glass. The metal base can therefore be made of some of the baser and cheaper metals. As this lamp, however, is not a vacuum lamp, it is deemed advisable to use a metal like platinum, which will resist the action of the gas employed.

The fact that the new lamp has a comparatively high pressure of gas within it renders the maintenance of a perfect vacuum chamber of less consequence than in the vacuum



ELECTRIC PENCIL IN PHOTOGRAPHY.

lamp. A seal which might not be satisfactory for a vacuum lamp, and perhaps could not be used for that purpose, might be entirely satisfactory for a gas lamp. The metal seal at the base obviates the necessity of joining glass to glass in the usual manner, and also the use of the internal seal piece, so that if the lamp is slightly damaged in the process of its manufacture, it may be repaired and resealed with very little additional trouble. Moreover, this form of base and construction permits the manufacturer to use the bulb itself an indefinite number of times and also the metal plates, as they are of comparatively large size and can easily be reclaimed from old lamps.

In this lamp the idea of perfecting the vacuum lamp has been abandoned for the reason, it is claimed, that a perfect vacuum being absolutely impossible, the vacuum lamp necessarily has a limit to its degree of perfection; in other words, the vacuum lamp based upon the idea of a perfect vacuum, which is unattainable, must of necessity contain within itself the cause of its own early destruction. In practice, it is claimed, the vacuum lamp, as ordinarily made, is quickly destroyed by a comparatively slight excess of current. For this reason Mr. Van der Kammer undertook the development of a commercial incandescent lamp on the principles set forth in the earlier gas lamp patents and publications concerning the incandescent lamp. Gas lamps were well known prior to the production of the vacuum lamp, and many kinds of gas were employed in them and at various degrees of density. Several difficulties were found with the earlier gas lamps, as, for example, it was found that the gas in the lamp, even though greatly attenuated, would tend to disintegrate or destroy the burner, possibly by the impact of its highly heated particles upon the surface of the burner. It was also found that with such gases as were then known, there was great loss of energy from the heating of the gas in the lamp. There were many other difficulties with the gas lamps, which finally resulted in the abandonment of the idea of producing a gas lamp and the substitution therefor of a vacuum lamp. Van der Kammer has turned again to the gas lamp as a means of avoiding the weaknesses of the vacuum lamp and has endeavored to produce a gas lamp which should not have the objectionable features of the early gas lamps. The new lamp, although containing a considerable quantity of gas, is said to be even cooler while burning than the ordinary vacuum lamp. There is no disintegration of the carbon, it is claimed, and no electrical carrying incident to overwork, even when greatly over run. For example, when a 100 volt lamp is run at 150 volts for a considerable time, the burner has been found to be normal in color throughout and practically unchanged. It is further claimed that the character of the gas employed is such that whatever injury the burner receives or tends to receive from such over-running, is promptly and completely repaired by the gas itself, so that in most instances when the lamp has thus been overrun, it will be found that the burner not only remains unchanged in its form and appearance, but that its resistance is actually slightly diminished, so that, for example, a 110 volt lamp burned at 160 volts for a short time will give the full candle power at 109 volts instead of 110.

Some of the delays in producing the lamp are attributable to the difficulty of obtaining the gas-producing substance in sufficient quantities. The gas employed is one which the inventor and the chemical experts of the company assert has never before been used in connection with incandescent lamps, and which it is very difficult to obtain. It appears, now, that all such difficulties have been removed. The manufacturers of this lamp claim for it great utility for certain uses, as, for example, on circuits supplied with current of varying pressure.

The fluctuation of several per cent. in the current will not vitiate the lamp or increase the resistance of its burner, at least not until such fluctuations have extended over a long period, or in other words, the practical life of the lamp.

There is a change in the method of construction which greatly simplifies the manufacture of lamps. Gas being constantly present, and the means of preserving or repairing the carbon being always at hand, the new lamp does not require such an elaborate process of manufacture as the vacuum lamp, in which the chief aim is to secure an initial vacuum of the highest possible degree, and to drive out of the lamp and all the parts the last trace of occluded gases. This requires an expensive process of pumping and electrically energizing the lamp during the process. Moreover, after this high degree of vacuum has been obtained it is necessary that the lamp shall be so constructed as to return the vacuum and permanently exclude all atmosphere from the lamp and close it against practically the whole of the atmospheric pressure. In the new lamp such perfect exhaustion is unnecessary.

This lamp will be called the new Sunbeam lamp, and

FIG. 1. VAN DER KAMMER'S INCANDESCENT LAMP.

will be manufactured by the Star Electric Lamp company, Chicago.

Ulsiah, Cal., is to have an electric railroad on its principal streets.

The Reading & Temple Electric Railway company of Reading Pa., has filed a notice of its intention to construct a system of of electric railways between Reading and Myerstown.

It is reported that an important deal was closed at Toledo, O., last week between J. K. Tillotson and George B. Kerper, of Cincinnati, who owns the Findlay electric street railway, by which a consolidation of interests has been effected for the construction of the electric railway that will connect Findlay, Fostoria, Tiffin and other North western Ohio cities and towns with lake resorts. A meeting will be held in Cincinnati soon to form a company, in which Tillotson and Kerper will be officers. The total mileage of the proposed electric road exceeds seventy miles.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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VISITORS

To the World's Fair are requested to forward their addresses to the WESTERN ELECTRICIAN as early as possible or notify us immediately upon their arrival in Chicago.

In the incandescent lamp litigation at St. Louis last week the Goebel claims were revived and an effort was made to strengthen the case as presented by the Beacon company at Boston. Additional affidavits were presented and it is claimed that evidence was introduced with a view of showing that the lamps originally made by Goebel and upon the practicability of which much doubt was expressed were really practical, though, of course, not perfected to the present state of the art. Decision has not yet been made on these claims, but it is not believed that there will be any radical departure from former rulings.

All interested in the subject of electric traction will rejoice in the announcement that a successful trip has been made over the intramural railway at the World's Fair, which is operated by electricity on an elevated structure. Many difficult engineering problems had to be met in the planning of this temporary installation. It had to be engineered as cheaply as possible, so that it would prove profitable for six months' service, and yet it must bear inspection as an exhibit of the latest step in electric railroading and be substantial enough to safely take care of the immense traffic expected. The engineering staff is to be congratulated on the result it has obtained without violating any of the conditions imposed.

Incandescent lamp makers will be interested in the new lamp of John Van der Kammer of Chicago, which is illustrated and described elsewhere in this issue. It will be remembered that this lamp was briefly described in the WESTERN ELECTRICIAN of March 25th. Since that time the details of construction have been perfected and the lamp is now ready for the market; in fact the lamps from which the cuts were made were manufactured for commercial use. In these new lamps there are two features upon which the manufacturers base their hopes of evading the Edison patent. In the first place, by the use of the platinum strips in the base of the lamp, it is claimed that the all-glass receiver feature is eliminated and at the same time the necessity of using leading-in wires is avoided. Then, too, it is claimed the new lamp is not a vacuum lamp but a gas lamp, and the inventor asserts that in going back to this form he has made a decided gain. He says that the inability of lamp makers to secure a perfect vacuum is the chief objection to the present form of incandescent lamp and that in discarding the vacuum for the gas lamp he has made an important advancement. His claims will undoubtedly be received with some reservation, but there is no doubt that the positive statements which he makes will be thoroughly investigated. It would certainly be a most remarkable circumstance if the present lamp controversy should result in the adoption of gas lamps in place of vacuum lamps, after the years of experiment and investigation which have been devoted to the development of the latter. The question of increased cost which the use of platinum will entail is met by the statement of the manufacturers that the platinum may be recovered, and that it is expected that a cheaper metal will soon be used.

In granting the Manhattan company additional privileges the Rapid Transit commission has practically turned over to that corporation the exclusive right to use the streets of the city of New York for elevated railways. This action on the part of the commissioners is greatly to be deplored. In the first place the "L" system can give only temporary relief at best, and in a few years the city will again be confronted with the question that has occupied so much attention during the last twenty years. It is merely putting off the final solution of the problem, and each additional grant will only serve to further entrench the Manhattan company and make the city's labor all the greater. A comprehensive system of underground roads could now be planned and future extensions provided for, but with the "L" system the best that can be hoped for is an occasional addition or extension, which will afford very little relief, and that only to a comparatively small portion of the population. But New York has pronounced against an underground system; the mayor says that the people don't want it and capitalists have shown no inclination to back up the project. The constitutional provision prohibiting the city lending its credit to private enterprises thwarted the plans of the capitalists who were willing to put up $15,000,000 as evidence of their faith in the project and their interest in the city's welfare. In the face of Mayor Gilroy's opposition it was not to be expected that the Legislature would come to the rescue of the people, and besides it is intimated that the city and state officials thought that if $35,000,000 or $50,000,000 of the city's funds were to be expended it should be so arranged that political organizations should have the benefit of handling the money and distributing patronage. Whatever may have been the cause, it is certain that the underground plan is killed for the present, that the elevated system has taken on a new lease of life and that the city will find it harder than ever to rid itself of the monopoly established by the Rapid Transit commission's grant of last week. It is a hard blow for New York and one that it will take many years to recover from.

Interest in the subject of the application of electricity in naval warfare is given a fresh impetus by the great assemblage of American and foreign warships in Hampton Roads in honor of the opening of the World's Columbian Exposition, which is close at hand. In all the modern vessels electricity is now employed in a threefold capacity—for lighting, including the indispensable search-lights; for power transmission, in moving the heavy guns, operating ventilating fans and the like, and for signaling. On the occasion of the drill of the "white squadron" in New York harbor a complete account of the electrical appliances on the flagship Chicago was presented in the WESTERN ELECTRICIAN, the date being August 5, 1891. Even since then considerable advance has been made, however, and naval officers look for a still greater extension of the use of electricity on vessels of war. In speaking of future naval operations one of the American officers now at Hampton Roads said:

Electricity is to be utilized, if not for propelling the ship, at least for every other purpose where steam has been thought indispensable. We already have electrical appliances by which vessels signal each other, and by which the captain in the conning tower may direct the firing or communicate with any part of the vessel. Within a short time the system will be so perfected that the commander in the tower will, by the means of electrical contrivances, have absolute control of every motion of the ship and the action of every gun, so that he will not be dependent upon the promptness or coolness of his subordinates. When that day is reached a naval battle will be more than ever a contest between two men.

Some of the leading electrical engineers of the country were formerly officers in the navy, and are well acquainted with the needs of the service, and a large proportion of the present officers, especially in the engineering branch, are well versed in the laws and practical applications of electricity, and are enthusiasts on the subject. With all these keen minds at work it will be strange if our cruisers and battle-ships do not come more and more under electrical control, with all the circuits leading to the master mind in the conning tower. There is something terrible in the thought of two great ships of war engaged in a battle of extermination, which is in reality a scientific encounter between the two commanders, each grimly yielding the weapons of destruction under his control by means of a network of electric wires. But that seems to be what is coming, and, on large ships at least, the individuality of junior officers and seamen must give away before the ubiquitous current of the battery and dynamo.

When there is a job of plain, unvarnished lying about the World's Fair to be done, there is probably no newspaper in the United States that can accomplish the task with as much brazen effrontery as the New York *Sun*. The *Sun's* jealousy of Chicago has led it to make a ceaseless warfare of vituperation on the exposition ever since Congress located the fair in the western metropolis. An occasion for an unusual display of mendacity appears to have arisen a few days ago, however, for an item headed "Chaos at Chicago" appeared in the *Sun* of April 14th, in which that journal gave circulation to a tissue of falsehoods easily outclassing all previous efforts in that line. The lying, although noteworthy for the extent to which the facts are perverted, is much below the standard of the *Sun's* art, for the prevarications are so palpable as to be absurd. For instance what could be more bare-faced in the shape of a falsehood than the statement that "None of the buildings is completed; none is likely to be completed by May 1st, the date set for the opening." The truth is, of course, that nearly all the large buildings are entirely completed. About the only ones on which work of any consequence is being done are the administration and machinery buildings. Some, like the woman's and horticultural buildings, were turned over by the contractors nearly a year ago. The work now under way is mainly on smaller buildings, begun this year, and on the installation of exhibits and clearing of the grounds.

In the *Sun's* manufactured arraignment, which is put in the shape of a dispatch from Chicago, it is stated that "In the electricity building, for example, which has fifteen or twenty acres of ground space, just one exhibit has been installed." Of course, this is simply another lie. In the first place, the electricity building has five and one-half acres of ground space, and not fifteen or twenty. In the next place, there are probably one hundred exhibits installed instead of one. Not more than half a dozen displays, perhaps, are entirely completed, as the opening is set for the 1st of May and not the middle of April; but a very large proportion of the exhibits is now installed in the building, and the work of embellishment and booth-building is proceeding in every part of the structure with such encouraging activity that it is morally certain that the interior will be ready for inspection in the early days of May. It is not to be presumed that the last finishing touch will have been put on every exhibit by the first of the month, but it may be confidently asserted that the display will be more nearly completed than that of any one department of any previous international exhibition.

Of course the announcements that "the World's Fair is in a state of chaos" and the like are merely malicious nonsense, and it would be a waste of time to dwell on each one of the falsehoods which are contained in the alleged dispatch referred to. We simply desire to assure the eastern members of the electrical fraternity who may be disposed to discredit the electrical display, owing to the violence of this and similar attacks, that the references to the electrical exhibits are as ridiculously false as their own good sense must show them the general diatribes to be.

Incandescent Lamp Litigation.

The city of St. Louis was last week the center of interest for those engaged in manufacturing and using incandescent lamps. On January 17th last the Edison General Electric company was granted an order restraining the Columbia Incandescent Lamp company of St. Louis from making and shipping lamps. On Thursday last the case came to trial on the motion of the Edison company for a preliminary injunction to prevent the Columbia company from manufacturing lamps.

The cause was heard by Judge Moses Hallett of Denver, in the United States Circuit Court in St. Louis. R. N. Dyer of New York made the opening argument on behalf of the Edison company. He was followed by W. C. Witter and William H. Kenyon, New York, for the defense. They were followed by Clarence F. Seward of New York and F. P. Fish of Boston, both for the Edison company, Mr. Fish closing the case. Additional counsel in the case were Judge Henry Hitchcock for the Edison company, and Judge E. B. Adams and Messrs. Fowler and Fowler of St. Louis, for the Columbia company.

The defense was based upon the claimed manufacture and use of the incandescent lamp by Henry Goebel, prior to Edison. Some 250 affidavits were filed in support of this claim. An interesting feature of the case was the fact that the Goebel lamp "No. 4," which was looked upon with some suspicion by Judge Colt in the decision of the Beacon case in Boston, was here supported by a formidable array of affidavits. The authenticity of this lamp was further claimed and an effort made to sustain it by the introduction of a new lamp, designated as 'No. 9," this lamp, according to the defense, having been made at the same time and in the same manner as "No. 4." This lamp was in the possession of John C. Goebel of New Haven, Conn., a son of Henry Goebel, who makes affidavit that it was given him, with two others, by his mother in June, 1878, just previous to his intended departure for Europe, it being his intention to show the lamps to an uncle in Europe. The date of this event is fixed by a passport, which was filed in evidence, and which was dated June, 1878. Mr. Goebel, however, did not go to Europe as intended. The other two lamps given Mr. Goebel by his mother were given away, one of them to the engineer of the Bigelow Manufacturing company of New Haven, Conn., who burned it in connection with a dynamo. Mr. Goebel kept lamp "No. 9," showing it frequently to members of his family and others. In October, 1878, he was engineer at the German Hospital in New York, where he showed the lamp to various people. The records show that he left the hospital in 1879. He afterward went to New Haven as an engineer, keeping the lamp in his trunk, and showing it frequently. All three lamps were identified by several people as having been seen in the German Hospital in New York in October, 1878. Further evidence of practically the same character as that introduced in the Beacon case was presented.

The Edison company offered in evidence 450 pages of affidavits. This was also practically a repetition of the evidence on the Beacon case. Seventeen witnesses saw the telescope exhibited on the streets of New York, and identified the person making the exhibit as Goebel. They did not know Goebel, and saw no lamp used in connection with the exhibit. Some 250 pages of the evidence are from witnesses who saw the telescope, but no lamp. The remainder of the affidavits are from experts who testified as to the condition of the art in 1878, from which they felt convinced that it was then impossible to manufacture or operate such lamps as those claimed to have been made at that time by Goebel.

It is claimed that since the decision of the Beacon case Goebel has taken the same apparatus which he originally used, and has reproduced lamps similiar to those submitted in evidence, and has shown them to be operative.

The case was closed at 4 P. M. Friday, April 14th, and is in the hands of Judge Hallett, who has promised to deliver an opinion within a week, if he can find the time to go through the records.

Considerable interest has been manifested in the progress of this case, the court room frequently being crowded. The electrical people of St. Louis particularly spent as much of their time as they could possibly spare in the court room. J. H. Rhotehamel, president of the Columbia company, has given the matter of the defense of this case a great deal of time, study, and hard work of late.

The Fox River Electric Railway company of Elgin, Ill. has decided to build an electric line from Elgin to Aurora, passing through St. Charles, Geneva and Batavia. It is said that a line will also be built from Carpentersville to Elgin. If this is done, it means the construction of a continuous line of 28 miles.

Rapid Transit for New York.

The plan for securing rapid transit for New York city by means of an underground system of railways has been defeated. As soon as the plan was announced Mayor Gilroy announced his opposition to the measure, and, as the act under which the commission was working confers upon the mayor the power of vetoing any plan the commission may adopt, the plan was practically killed before the commissioners went through the formality of receiving a report from their counsel. The mayor said that he was opposed to any scheme by which the city should lend its credit to, or become in any way connected with, a private enterprise. The only objection that had been made to the underground plan was the failure of its advocates to secure the necessary capital. It had been contended that this capital could only be secured at ruinous rates of interest if the project were conducted as a private enterprise, and the mayor expressed the opinion that this was sufficient reason for the city keeping out of the deal. If it was a good investment he believed plenty of capital could be secured without appealing to the city. The credit of the city at the present time is excellent, but the mayor said it would not long remain so if it adopted the policy of lending its credit to such enterprises. It would soon reach the limit allowed by the statute, and public improvements would be brought to a stand still. The condition of Brooklyn was cited as an instance illustrating this point. Concluding his statement, Mayor Gilroy said: "I don't know much about the plans of the Rapid Transit commission. I might as well say right now and in this way save the Rapid Transit commissioners a good deal of trouble, that I shall never approve any plan which they may formulate or any plans which some one else may formulate, and which they may present, which contemplate the expenditure of the city's funds or the lending of the city's credit."

The mayor is opposed to underground roads generally, it should be remembered. He said: "I do not believe the citizens of New York want an underground road. They have an underground road in London. We have our line from Forty-second street to 125th street, and it is intolerable in the summer. So far as the London road is concerned, it is an abomination. I have ridden on it, and I, know what it is."

Referring to this interview, Chairman Steinway of the Rapid Transit commission said: "I believe that this underground road should be built by the city under the plan offered by Mr. Wilson. The city's share cannot exceed $35,000,000. It would be so limited by law. The road should be built under the supervision of a commission of citizens rich and honorable and retired from business, men who are not identified with any railroad enterprise. I readily understand the chief ground on which Mayor Gilroy now stands. He has with wonderful energy pushed to consummation a great many public improvements that have been delayed for years, such, for instance, as the widening of Elm street and the creation of the speedway, both splendid and absolutely necessary measures, and perhaps he does not believe that it would be judicious to approach too near the constitutional limit of indebtedness; but, nevertheless, this is a needed and a vast enterprise, strictly for the city's interest, it seems to me."

Mr. Steinway added that he was sure that the cost of the road could not exceed $50,000,000. He had obtained estimates from contractors, and he knew. He was certain that it could not be built by private enterprise, and that it would not hurt the city's wonderful credit to issue the necessary bonds. He said also: "Extension to the elevated railroad must be granted. I shall do all that I can to secure that, in order that immediate needs may be supplied."

When the matter was taken up by the commission at its meeting on Tuesday, John M. Bowers presented his opinion on the legal status of the case. He declared that such a proposition could not be accepted, as it was unconstitutional. Mr. Wilson's propositions were then withdrawn, and the commission then proceeded to consider other plans. Mr. Starin submitted a plan for a road partly underground and partly elevated, but this proposition was rejected. Mr. Spencer's plan was finally reached and at this point Mr. Starin, who had all along opposed the invasion of the boulevard by the Manhattan company, said in the course of a speech:

As the members of the Rapid Transit commission are aware, I have always held the view that any extension of the existing elevated railroad system can at the best furnish only temporary and inadequate means of local travel to the people of this city. At the same time I have from the first stated that I would not place my individual opinion in opposition to the expressed views and will of all the other commissioners.

In this view I am ready to relinquish my personal preferences and to act upon this question without further delay. At the same time I am fully convinced that in conjunction with it we must act upon the question of compensation as well.

Being desirous of fixing such compensation at a sum against which no possible complaint can be made by the Manhattan company, I have concluded to adopt the theory of the law under which the West Side & Yonkers Patent Railway company was organized, to which charter the Manhattan Railway company succeeded, and to assent that the additional concessions be granted upon the Manhattan company contracting to pay to the city 5 per cent. upon its net earnings, not alone of that part of its road which it acquired under the above legislation, but also of that part of its line on which it now pays nothing, and upon the proposed extensions and additions.

Unless the company desires to pay nothing for the franchise it can scarcely ask lower terms. The plan proposed removes the objection that has been made that the operation of the additional facilities will increase the proportion of the road's operating expenses as against its gross earnings. It imposes no obligation upon the company which will have to be paid without reference to its net earning capacity, and leaves a corporation with a monopoly of the elevated railway system in the county of New York paying only 5 per cent. upon its actual net earnings from year to year.

This proportion was finally accepted, and the commissioners voted to give the Manhattan company exclusive control of the elevated lines of New York city. The plan was submitted to the Manhattan company, and, it is believed, will be accepted as a final adjustment of the case.

The attitude of the city officials toward the underground plans proposed has caused considerable comment. The *Times* says:

A gentleman who has been actively interested in the work of the commission, and who is very hopeful that something may yet be done to provide genuine rapid transit, said yesterday that he had become convinced that the opposition of the city authorities to the project for municipal construction was based mainly upon the fact that by the terms of the Ellison bill there would be no patronage in the work, while it would consume a great deal of money that might otherwise be devoted to projects that permitted a good deal of patronage.

He thought the only way that the city authorities could be made to acquiesce in plans that had been seriously advanced for underground construction would be by a popular demand that the work be pushed forward regardless of all political considerations.

English Comments on the St. Louis Convention.

Commenting upon the proceedings of the National Electric Light association generally, and the recent St. Louis convention particularly, the London *Electrical Review* says:

Some of the topics discussed at these conventions run in grooves, that is to say, some theme or another receives an unusually large share of attention. During the earlier period of the association's existence, electric lighting was the principal subject; indeed, the society adopted the title "National Electric Light association." More recently, papers on electric railways almost monopolized the atmosphere of the meetings. This year no fewer than three papers were read relating to the electric transmission of power, and a few remarkable statements dropped from the mouths of speakers.

In reviewing Dr. Bell's paper the following statements are made:

He [Dr. Bell] points out all the advantages of the multiphase system, even to the distribution of light incandescent lighting, although we do not know of a single instance in the United States where the system has been employed on a commercial scale. We can only conclude that he can only draw his inferences from what has been accomplished in Europe, notwithstanding his sarcastic remarks. He adds that there is a possibility that we may have before long practicable motors to run on an ordinary alternating circuit, constructed as suggested by Prof. Elihu Thomson a few years ago. C. E. L. Brown, abroad, has been making a desperate effort, says Dr. Bell, to exploit these new methods on his own responsibility, and has obtained motors which run successfully, but, as yet, do not start well under load. In connection, we would point out that we have recently seen a number of alternating motors constructed by C. E. L. Brown, of ½ to 20 horse power capacity, driving machinery, workshops, sawmills, lifts, etc., with a perfect success, and we have had the opportunity of testing the self-starting qualities of some of these motors. Here, again, Europe is ahead of America in the practical application of a useful invention.

Concerning Mr. Stillwell's paper the following comment is made:

We need not refer at length to this communication except that the author ventures a remark to the effect that very few men even among those who are actually operating central stations are able to say exactly what the power costs them, and that it is not surprising that the engineer who is called upon to lay out, let us say, an elaborate plan for the utilization of water power, finds it difficult to give explicit answers to questions relating to the cost of operating such a plant, probable revenue to be derived from the sale of power and in general economic feasibility. We trust that this remark applies only to his side of the Atlantic.

A controlling interest in the Enterprise Street Railroad company, Charleston, S. C., will probably be secured by the Great Western Manufacturing company. In such an event electricity would be adopted as the motive power on the lines.

Country Roads and Electricity.[1]

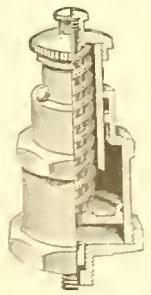
The Wheelmen's League is agitating a scheme for improved country roads which is modestly estimated to cost not more than $10,000,000 in the state of New York. They have introduced a bill in the Legislature for the promotion of this object, and to mollify the farmers, who are expected to object to the trifling expenditure, it is announced that only a small part of the cost will be levied on the agricultural districts. It is not announced, however, where the weight of the levy is to fall, and in the absence of more definite information it is presumed that the main part of the cost will be assumed by the bicyclers themselves, the young fellows who compose the league. The cities are careless about bicycling, and it is not thought that they could be drawn into the scheme without even a greater effort than it takes to paddle a bicycle over a muddy road.

There is an alternative plan, however, which has been considerably agitated among electrical engineers and manufacturers, and it is one that cannot fail to be of great interest to farmers when it has generally been brought to their attention. It is a plan to lay electric railways on all the country roads, and, through the general distribution of electrical power, to enable the farmers to not only travel wherever they please to go, at about any rate of speed that they are willing to risk, in vehicles under their own private control, but to do a large part of their farm labor by electrically propelled agricultural implements. The arguments in favor of this plan may be summarized as follows:

First, it will make the cheapest and the only comprehensive system of road improvement that can be considered practicable for a country so large as the United States. In most sections of this country a district 10 miles square contains about 100 miles of roadway. In the western states the mileage is greater; but in the East and South it is sometimes even less. But in a district 10 miles square there are 600 one hundred acre farms, or their equivalent total of 64,000 acres. Then, as the electric motor has a wonderful facility for running up hill and there will be little or no grading required, it is not difficult to estimate the cost.

Taking a district 10 miles square, the surface that can be served from a single central power station, and estimating on the cost of the track, poles, wires, and central power stations of the electric railways already in operation as a basis, it is maintained that a total capitalization of $10 per acre would be sufficient to provide an electric railway system in the country, not considering any further agricultural use of the electric power. This would mean an annual interest charge of 60 cents per acre, or $60 for each 100 acres of land in the district. It seems like a very trifling expenditure when we consider the magnitude of the service proposed. But, of course, to this estimate must be added the operating expenses, and the interest on the cost of the electric wagons owned or rented by the farmers. In the calculations of the electrical experts, however, the total is not made to equal the expenditures entailed by our existing road system when we count the saving of time as an incident of value. As to the profits of the operating companies, they would accrue to the farmers themselves if they become, as it is maintained they should be, the chief stockholders.

Next after the claim for greater economy comes the claim for greater efficiency in service. The advocates of an electric system of country roads maintain that it costs a farmer who lives at any considerable distance from town more money to get his produce to market than it afterward costs to get it to New York, or even to Liverpool; and, whether this claim be well founded or not, it is certain that, if a farmer places any value upon his time, the marketing of his produce is a very expensive undertaking. But with an electric railway in operation he need go to no considerable expense for this work. The companies owning the electric plant could send cars or trains to the different farm-

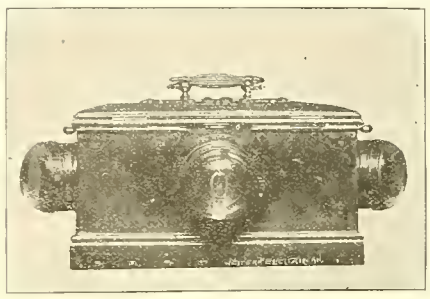


NEW AUTOMATIC SELF FEEDING CUP.

yards, collect the produce, and deliver it at the nearest market town for a small part of the cost entailed by slow horses and wagons, even estimating time as of no value. But this would be only the beginning of the farmer's advantages. The ability to travel at any hour of the day or night and through any kind of weather, in a perfectly protected vehicle at the rate of eighteen or twenty miles an hour, would be a source of inestimable convenience and comfort.

The third advantage claimed for the system is still broader than even the claim of greater economy, greater convenience, and more generally efficient service. It is commonly known that during recent years the increase of population in this country has been flowing in a disproportioned ratio toward the cities and large towns along the line of railway communication, while the little country villages remain merely cross roads hamlets, without growth or progress of any kind. This is due to the fact that the manufacturing interests of the Union are rapidly growing, and that along the line of railway communication offer the advantages of cheap production and the cheap distribution of merchandise. It costs too much to distribute coal through the country districts to permit its use for anything but domestic purposes. But with a system of electric railways in operation this disparity would disappear. On account of the greater cheapness of lands and rents, the smaller villages would become the most available points for cheap production, even while the steam engine and coal remained the only source of manufacturing power. But with the general distribution of the current would come also the general distribution of electric power; and this would add to the inducements of the country as a field for the manufacturing industry. Then the rural villages would begin to receive their fair proportion of the increase of population, and this would react upon the farmers greatly to their advantage. Truck farming would soon become universal, instead of the exclusive industry of suburban farmers, and farming operations could be universally conducted with greater profit.

But the projectors of an electric system for the country do not limit their claims to merely material considerations.



ELECTRIC YACHT LANTERN.

It is very well known that, owing to sparse population and the difficulty of intercommunication, the educational institutions of the rural districts are very defective. But it is suggested that with electric railways in operation only one school in a township would be needed, and that this school, while it could be made equal to the best city schools in every educational advantage, would be superior to the city schools, with their mixed attendance, in moral advantages. Children could be transported between their homes and a centrally located village school without serious loss of time, and the demoralizing associations incidental to attendance on city schools could be avoided. Then the country would become an ideal place for the training of children, and this would bring a further influence to bear in favor of a more rapid increase of rural population. It is certainly true that the superior educational advantages of the cities are among the chief causes for their rapid growth at the expense of the country.

Finally, the argument takes a range as wide as our political and social science. The effect of practically concentrating a territory 25 or 30 miles square into a space no larger than a 5 mile radius under the ordinary resources of transit is broadly considered, and it is concluded that the social results must be beyond calculation. First after the consolidation of schools and the coming of better teachers would follow the consolidation of churches and the advent of better preachers. The people of large districts would thus be brought into more intimate relations with each other, and a more cosmopolitan spirit would be engendered. Entertainments of an intellectual and innocent kind would be found also everywhere within reach, and country life, made larger socially and more varied, would lose the monotony and dullness which now drives so large a proportion of the sons of farmers to the cities. The country, indeed, would become an ideal place of residence. Even the postman and the newsboy could go their daily rounds and the morning newspaper would become as familiar a visitor at the farm-house as it has long been at the urban or suburban dwelling. In truth, the number of postoffices in the United States could be reduced three-fourths, it is believed, and a better service rendered from the remaining one-fourth than we can ever expect to see under prevailing disadvantages.

But even yet the arguments in favor of extending the electric system into the country are not repeated in full; and it may be thought by some persons that the reason still to come should have been placed first and made the inspiration of the entire plan. The farmers, it should be pretty well known by this time, are not altogether satisfied with their profits. They think that with their large capital invested, about the largest, according to statistical estimates, in the country, they should be able to get larger returns. But it is doubtful if they can ever get larger returns from exclusively agricultural operations, or not, at least, until all the arable land is taken up and the fatal facility with which new men may become farmers is checked by the cost of investment. What the farmers seem to need is an independent field for investment—a field that will enable them to put their savings into income-producing property beyond the reach of the fierce competition of the plow and the cultivator. This, it is claimed, is precisely the field that will be opened by the electric motor. The companies building and operating the electric power plant will find a wide source of profit. They will find it not merely among the farmers themselves, but in the rural villages, soon to become considerable manufacturing towns, demanding light and power. The day is not now distant, either, when the telephone patents will expire, and then the telephone may be brought into universal use and made to contribute largely to the profits of the companies. All this can be made to accrue to the profits of the farmer, if he will display sufficient enterprise to take advantage of his opportunities.

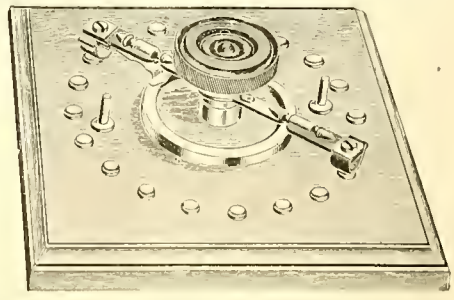
These are some of the arguments advanced in favor of pushing out the electric service into the country. But for the discomfiture of the Wheelmen's League there is still another argument which interposes with peculiar force against their expensive scheme for old-fashioned road improvement. It is urged that the general adoption of the railway system in this country of magnificent distances and difficult means of intercommunication is inevitable, and that any kind of improvement that contemplates the perpetuity of horse traction on the highways would be a mere waste of money. It is consistently claimed that there will be absolutely no occasion for any farmer or other citizen of the rural districts to go upon the roads except in electrically propelled vehicles after the electric system has been brought into general use, and that the time when it will be in general use is not distant in any event. The stimulus to activity will not be lacking, because it is believed to be the best field of investment in the United States, and too promising to be neglected, even should not the farmers themselves become the promoters. The capital invested in electrical manufacturing in this country now amounts to many hundreds of millions, and, in addition to this large total, the iron industry and other branches of industry engaged in manufacture of railway rolling stock will be equally concerned with the electrical manufacturers in the extension of the railway system. All these large interests will work together for a common end.

At present the electrical manufacturers are overburdened in filling orders for street railways, and they are compelled to continually enlarge their plant to meet the demand. But in the course of a few years, four or five years at the utmost, the urban and suburban demand will be pretty generally met, and the orders will begin to fail. Then we can look to see the next step taken. It would not be consistent with the character of the American manufacturer to abandon a portion of his plant when the whole continent remains to conquer. He will push out into new fields, and invade the country. The country stage coach has gone. The country road must follow, and it is not believed that it would be sensible to bond the state of New York for $10,000,000 for such roads, when in less than twenty-five years at the furthest they will have to become a tradition, and the bonds alone would remain as a memento. A $5,000 a mile macadamized road would be no better foundation for an electric railway than a dirt road. It would not be so good.

It is possible that against these claims the advocates of improved roads may suggest the storage battery system, and urge that we may have both improved roads and electricity. But it has been observed that wherever the obstruction of cost—the present obstruction for the storage battery—throws itself in the way of electricity it proves to be a very obstinate obstruction. It does not look now as if the storage battery could ever be more than a subsidiary source of power. Then, again, electric vehicles could never be driven at the high rate of speed that would be demanded in the country, except over iron rails.

New Automatic Self-feeding Cup.

In the accompanying illustration is shown a sectional view of a new automatic self-feeding cup known as the "Lackawanna." These cups are adapted to almost every possible variety of service, from the heaviest to the lightest, having regular pressure at every point, whether full or empty, and giving the spring equal tension. They are used on engines, line shafting, machine tools, elevators and electric motors. The Clarendon Oil & Refining company of 114 North Front street, Philadelphia, Pa., has adopted this cup, and to insure its use furnish it to all its regular customers. Many customers prefer grease, with no waste or



NEW VOLTMETER SWITCH.

oil drippings, when used in connection with this cup. This cup is in use by some of the largest manufacturers and railroad companies in the country, and is becoming quite largely known and adopted by users of electrical apparatus.

New Electric Railway Project for Chicago.

One of Mayor Washburne's last official acts as chief executive of the city of Chicago was the signing of an ordinance passed by the city council on April 5th granting the Chicago & Jefferson Street Railway company a franchise for a road beginning at Elston and Milwaukee avenues, and extending northwest to the city limits, with several branches. Electric motors will be employed, and the company is given the privilege of constructing an overhead trolley line under direction of the commissioner of public works.

Galva, Ill., will soon be electrically illuminated.

A New Trolley.

The Allen Trolley company is the name of a new firm located at 123 North Third street, Philadelphia, which is bringing out a line of trolley appliances that is attracting much attention and which is already having a large sale. Fig. 1 shows a new trolley spring which has many points of merit. In contact with the spring are two small pulleys which insure positive action of the spring in holding the trolley wheel to wire. In Fig. 2 is shown the parts of the trolley arm—the principal feature being that the shaft of the pulley and wheels revolves and not the wheel alone in fibre graphite bearings, which do not require oil. A recent test of 900 miles was made. The contact is positive and

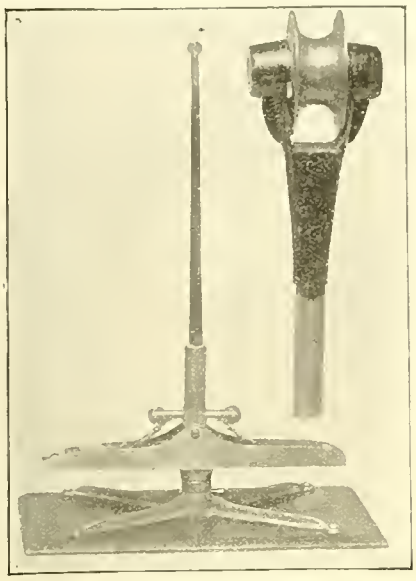


FIG. 1. A NEW TROLLEY.

insures full effect of current. The claim of this company in having an oilless, noiseless and clean trolley will be much appreciated by companies operating electric roads.

New Voltmeter Switch.

With the increasing number of isolated plants electrical practice and apparatus in this line becomes more important. Nearly all large buildings of modern erection maintain their own plants, often very extensive and complete, and usually including a switchboard of slate or marble holding the apparatus for the control of the plant. The grouping of a number of machines in this way, feeding into common bus bars, renders necessary means of controlling each one at any time and uniting its action, especially with reference to voltage.

For the latter purpose the Electric Engineering & Supply company of Syracuse, N. Y., has recently placed upon the market, in connection with its switch boards and voltmeter, the voltmeter switch herewith illustrated.

As the name indicates the instrument is to be used in connection with a number of generators in place of the primitive strap switch or the cumbersome plug method adopted when the number of circuits becomes too large for the former. They are made in two styles, single and double pole. The arm is brass, of two pieces, insulated and mounted on the central support. A light spring contact piece is carried on the lower side at each end, and as the arm is rotated by the corrugated hard rubber disk at the center, these touch diametrically opposite posts. One contact spring is lengthened to bear on the ring on the base, and between this ring and the other arm through the center post the voltmeter is connected. The test wires from the circuits are brought to opposite posts, and by turning the arm the voltmeter may be connected to any circuit or cut out. Stops are provided to prevent reversal of the current.

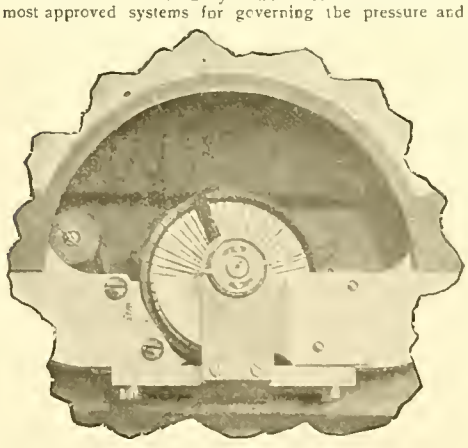
While there is nothing especially new in this instrument, its convenience, neat appearance and workmanship commend it to all station men and electrical users who look after the details of their plants.

Electric Lantern for Yachts.

A new and practical idea is presented in the accompanying illustration of an electric lantern for use on small pleasure yachts. This lantern is placed on bow of boat. It consists of three bull's eyes, showing white light ahead and the starboard and port lights respectively. Each bull's eye is illuminated by an 8 candle power 6 volt Edison lamp. Current sufficient to run the lamps six hours on one charge is supplied by three cells of the Franklin storage battery. These cells are made of slate to prevent spilling of the solution. Connections for charging are made through binding posts at the back of the lantern. The lantern is made of highly polished brass and measures 12¾ by 5 by 6¾ inches and weighs, complete, 38 pounds. This lantern was made by the Franklin Electric company, 106 Liberty street, New York. This company recently made a carriage battery consisting of five cells enclosed in a box which is placed under the coachman's seat to supply current for a 12 candle power 10 volt lamp placed in a cone-shaped reflector. The lantern and carriage lamp were made from the designs of F. K. Irving.

Introduction of the Electric Railway in Bangkok, Siam.

The operation of electric railways is not understood in Siam, and the people of Bangkok looked with awe upon the first electric car which was recently started upon the road of the Bangkok Tramway company. Regarding the substitution of electricity for animals on the street railways, the Bangkok *Times* gives the following interesting account: "Arrangements were made through the representatives of the Brush Electric company in China and Japan, to supply the plant necessary for working the tram cars. Under the very able and energetic superintendence of W. J. Davison, electrical engineer for the Short Electric Railway company, boilers, engines and generators have been fixed in a very substantial manner, and the three miles and more of track have been connected by means of electrical conductors in an extraordinarily short space of time, when it is considered that the rough material procurable in Bangkok constituted the only help means and appliances at his disposal. Arrangements were made for a preliminary run to test the efficiency of the plant on Monday night. The central station at Klong Padung was lit up with a number of incandescent lamps and the engines put in motion. As word had been spoken of a trial, a motley crowd, consisting of all nationalities, had collected to see the result. Excitement became intense when the lamps on the car were lit as if by magic, and shortly afterward the vehicle was seen to move. A preliminary run as far as the Oriental avenue and back proving successful, a few friends of the manager of the company stepped on board the car. A run at the rate of about 15 miles an hour soon brought the car to the end of the line, where other cars were to be seen under construction. Everything worked most smoothly, as far as the machinery was concerned, and the run was unanimously declared by all to be an unqualified success. An occasion of this kind could not be well ended without the usual christening, and this was done by the invited guests at the manager's house. The electric plant supplied by the Short Electric Railway company of Cleveland, O., arrived on November 16th last. The installation covers a distance of a little over three miles. The plant consists of two 80 horse power single cylinder automatic-cut-off engines, built by the McIntosh & Seymour Engine company, having a 13½ inch cylinder and a 12 inch stroke, working at 284 revolutions per minute. The engines are driven by steam conveyed from two horizontal tubular boilers, 16 feet long by 60 inches in diameter, having a working pressure of eighty pounds and supplied with water feed by a Worthington pump through a Jones feed-water heater. The furnaces are large and specially adapted for wood fuel. There are two generating dynamos giving 100 amperes of 500 volts each capable of being worked singly or in parallel. The electric current is indicated and controlled at a switch-board by instruments of the latest and most approved systems for governing the pressure and



NEW KENNELLY AMMETER.

connecting the dynamos, working either singly or in pair with the line. On the switch-board is a very clever device termed a circuit breaker, designed with a view to minimize risk. This ingenious invention guards against the possibility of a superfluous amount of electric current on the line, or on the trolley, by automatically cutting off the circuit and leaving the line free from current. The overhead wire consists of No. 2 hard drawn copper and is suspended by steel brackets and insulated hangers from poles at the side of the road. The entire length of 17,200 feet is in three pieces only, joined by two sleeve joints. The return current is conveyed through the rail, which have in this instance, owing to defective conductivity, been carefully connected by galvanized iron wire bonds passing through holes drilled in the extremities of each rail, and riveted. These bonds have in turn been soldered on to a supplementary wire running the whole length of the track and are connected with the switch-board at the central station. The cars, very solidly built of teak, are mounted on an all-iron truck, especially adapted for tramway service and carrying a 20 horse power motor. They are also fitted with five incandescent lamps of 16 candle power each."

New Kennelly Ammeter

This instrument, as shown in the cut, consists of a flat, horseshoe magnet, with its poles brought out into semi-circles, facing each other and separated by about 1-16 th of an inch. This large polar surface and narrow air gap make a magnetic circuit very nearly closed. It is well

FIG. 2. A NEW TROLLEY.

known that a solid anchor ring of steel uniformly magnetized around its circumference has no demagnetizing force, and therefore no tendency to alter its magnetization. A saw cut across such a ring introduces an air gap that establishes a demagnetizing magnetomotive force equal to the product of the flux and the air gap reluctance. As the air gap broadens and its reluctance rises, this back magnetomotive force increases, making the magnetic condition of the whole circuit more and more unstable, and rendering it more difficult to find a quality of steel that will have sufficient hardness and retentiveness to withstand this demagnetizing influence, while the narrower the air gap the more permanent and stable the magnetic condition must remain.

In the narrow space between the semicircular pole faces is pivoted a disk armature, as shown, the plane of the disk being parallel to the polar surfaces and midway between them. Starting from the center, the insulated wires forming the armature winding are laid radially and symmetrically over the upper surface of the disk, the accuracy of angular spacing being mechanically preserved. One half of the disk is completely covered by the pole faces and the other half projects beyond them. The spiral springs bring the measured current into and from the disk, acting at the same time as a restoring couple, as in the instruments of Cauderay and Gimingham of 1886. When the current passes through the armature an electro-magnetic pull is set up in the plane of the disk, urging it to right handed or left handed rotation, according to the direction of the current. As the disk moves in obedience to this force, as many radial wires enter the poles on one side as leave them on the other, so that the electro-magnetic force corresponding to the current strength remains uniform, while the retractive force from the spiral springs increases directly with the angle of displacement. In this way the angle through which the disk and its attached pointer move is proportional to the current strength, and the graduations of the scale are nearly uniform. The scale itself is wide, and covers an arc of about 125 degrees.

The shaft bearing the disk is pivoted on agates to reduce friction, and the whole armature complete only weighs a few grammes, so that it is not liable to be damaged in transport. The instrument will register in any position, but is most sensitive when resting horizontally. The total absence of iron from the armature insures freedom from hysteresis or magnetic lag. The instrument is very light, weighing six pounds in wooden case. It can be made in any capacity up to 100 amperes. It is not affected by the earth's magnetic force,

nor even by the stray field from dynamos beyond a few feet radius. Its resistance and inductance are very low. Its frame is strong and compact, being supported entirely on the magnet, which is again secured to the base with the intervention of soft rubber washers.

The instruments are all adjusted and standardized at the Edison Laboratory, by comparison with the standards there maintained. The scales are read off over mirrors to avoid parallax, and the movements of the needle are practically deadbeat. No ammeter of this type has yet made its appearance in which the magnetic circuit is so nearly closed, and this is the special advantage of the disk armature form.

A considerable advantage possessed by this form of ammeter is its independence of the distribution in magnetic flux through the armature. If this latter consisted of a spool or compact coil moving from one part of the field to another, under the influence of the current, the electromagnetic force, and consequently the deviation of the pointer, would depend upon the local intensity of the field at the point then occupied by the coil, so that accidental variations in the distribution of flux between the poles of different instruments would essentially produce corresponding variations in their scales. In this instrument, however, the winding is spread uniformly over the surface of the disk armature, which is only partly covered by the field, and consequently no movement of the armature within the range of indication can alter the relation between winding and magnetic field, however irregular the latter may be, for as many wires enter the field as leave it, and if any part of the winding is exposed to an unduly great or unduly feeble flux density at the outset, the same number of wires will always remain under that influence throughout the motion. This insures great regularity in the scales of different instruments and also insures a uniformity of any accidental error in the same instrument all over its scale.

The instruments are manufactured by the Edison Manufacturing company of 110 East Twenty third street, New York city.

Wiremen of the Chicago Edison Company Strike.

Last Monday about twenty or thirty wiremen employed by the Chicago Edison company quit work. This number represents the union element in the Edison forces in Chicago. The strike was ordered by C. A. Roff, of the National Brotherhood of Electrical Workers, who was at one time employed by the company, but, according to the authority of an officer of the company, was found incompetent and subsequently discharged. Some time ago the officers of the union asked the electrical contractors in Chicago to sign an agreement drawn up by the union, but the contractors refused to do so and the strike was ordered, although the men were for the most part satisfied and were receiving good wages. The Edison company is not troubled by the strike in any particular and is conducting its work as usual. New workmen will be secured to take the places of those who have left and the company expects no future embarrassment from its wiremen.

CORRESPONDENCE.

New York Notes.

New York, April 15.—The Board of Electrical Control, which has been pursuing the even tenor of its way for some time, created something of a sensation at its meeting this week, by adopting a resolution introduced by Mayor Gilroy providing that all electric light poles not erected in conformity with the rules of the board be removed from the streets. The order affects fully three-fourths of the posts now maintained by the companies. The rules of the board call for posts with cast-iron bases and wooden tops. Such poles have been erected in Broadway, Sixth avenue, Forty-second, Twenty eighth and a few other streets. In almost every other thoroughfare which is lighted by electricity the companies have put up plain wooden posts, much cheaper than the regulation posts, which cost about $50 each. After the meeting the representatives of the companies petitioned the mayor to give them a few days of grace to make the change. The mayor referred them to Secretary Moss who with Engineer Kearney will direct the removal of the objectionable poles. It was ordered that low-tension subways be built in One Hundred and Twenty-fifth street between First and Third avenues; in Sixty-fifth street, from Ninth to Eleventh avenues; in Seventh avenue, from One Hundred and Tenth street to One Hundred and Twenty eighth street for both sides of the street under the sidewalks. High-tension subways were ordered in Pearl street from John street to Hanover square; in Battery place from Greenwich street to West street; in Park place, between Greenwich and West streets; in Spruce street, between Nassau and William streets; in Avenue B, from Seventh to Fourteenth street; in University place, between Waverley place and Fourteenth street, and in Fourth avenue, from Fortieth to Forty-second street.

The bill providing for extending the term of office and salaries of the members of the Board of Electrical Control was passed by the Assembly Thursday night, and will probably become a law.

Rapid transit in accordance with the plan that was unanimously adopted on Wednesday afternoon by the commissioners appointed for that purpose seems now to be in sight. It is almost certain that the Manhattan Elevated Railway company will accept the conditions and build the extensions. The only serious question likely to be raised is over the compensation that the road shall pay the city for its increased privileges. It is estimated that at present the Manhattan Elevated Railway company is paying into the city treasury annually about five per cent. on the net receipts for half of its system. If it complies with the commissioners' plan and conditions it must pay the city five per cent. on its net receipts for its whole system. In addition to this the company must pay the expenses of the commission, which will be about $250,000. Comptroller Myers said recently that he approved of the five per cent. tax stipulated for. It means, he said, five per cent. of the gross receipts, less taxes and operating expenses. "In this sense of the term 'net receipts,'" said the Comptroller, "it seems to me that five per cent. is a just compensation to the city for the privileges that it grants. There can be no evasion of these payments. We know what the operating expenses and the taxes now are, and when the extensions are in operation it will be easy to calculate what the city shall receive."

Commissioner Starin still clings to his theory that the underground railroad is the best scheme for rapid transit.

"I do not intend to abandon the idea of an underground road," he said. "I shall continue to advocate it and do what I can to secure such a road."

R. T. Wilson said that he was glad that the present facilities were going to be increased. He would not say, however, that he had given up his scheme for an underground road.

Should the Manhattan company accept the plan drawn by Mr. Spencer, there will be very little delay in complying with its provisions. It would probably take about six months to comply with the legal requirements before the road could begin constructing its extensions. The company will have to present to the commission plans and specifications to be approved and submitted to the mayor and municipal authorities for endorsement. Then the work may begin.

The Supreme Court of this state has decided that municipalities may levy taxes on telegraph and all other poles erected in the streets to carry the wires of telegraph or telephone or electric light companies. The decision is an important one, because it opens to cities and villages a new source of revenue, the exaction of which will tend to cause the removal of overhead construction.

Another feature of the local telephone controversy, and one that will not please the subscribers, is the discovery made by the *Herald* that relief through the establishment of rival companies in this city is hardly possible. Aside from the merits of the patent claims which the Bell company presents, it will be impossible to establish a system of underground wires without building new conduits throughout the city. While the law forbids the company owning the conduits to refuse the admission of other companies, the Bell company, which controls those already built, has filled them with its own cables, or nearly so, and it is not believed that the people will again submit to the tearing up of the streets for the purpose of building new conduits.

At a meeting of the State Railroad commission yesterday the West Chester Electric Railway company applied, through Lawyer Charles Strauss of this city, for permission to use the trolley on its lines, which run from Yonkers to Mount Vernon, from Mount Vernon to Pelham, from Pelham to New Rochelle, from New Rochelle to Glen Island, and from Mount Vernon to South Mount Vernon, and thence to Woodlawn, in all about twenty miles. C. W. H. Arnott of Poughkeepsie, filed a petition for authority to operate the New Paltz and Highland electric road by the trolley system.

The Edison Electric Illuminating company of New York yesterday filed with the secretary of state at Albany a certificate showing that it had increased its capital stock from $6,500,000 to $10,000,000. It is stated that the amount of capital paid in is $6,500,000, and that the whole amount of the debts and liabilities of the corporation is $3,500,000.

W. F. O.

Northwestern Notations.

Minneapolis, April 15.—A party of prominent electrical men from Pittsburg, Pa., visited Minneapolis and St. Paul last week for the special purpose of examining the cable conduit system. They seemed well pleased with what they saw. The party was composed of F. E. Degenhardt, of Chicago, who superintended the putting in of the Minneapolis system; G. W. Blaxter, vice-president of the Allegheny Electric Light company; Mr. Mead, chief of the bureau of electricity at Pittsburg; J. W. Willock and J. E Ridall, capitalists.

The wild storm that swept over the Northwest early this week was disastrous to all companies dependent on electricity. Reports from the towns throughout the state indicate that in many cases electric plants were considerably affected, but only temporarily. The telegraph companies here reported much disturbance all along their northwestern lines. In both Minneapolis and St. Paul the street car companies were bothered by the storm, but maintained their service. Several motors were burned out.

The Minneapolis aldermen are having a siege over the question of the proposed street railway station at Bridge Square. The legal right of the city to give this piece of public property for the use of the company without adequate compensation is called in question. The city attorney holds that it cannot be done. The company proposes to put up a regular depot building and believes it will prove a great public convenience.

Sixteen handsome open cars for the Minneapolis service are due this week from St. Louis.

N. L. P.

New England Notes.

Boston, April 15.—Rapid transit in Boston begins to take on a little more palpable shape. The legislative committee which has this matter in charge met on April 12th at the state house and listened to the reading of a bill which proposes to establish an elevated road in Boston. It is expected that this bill will soon be introduced in the Legislature. It authorizes the construction of an elevated road by a corporation to be known as the Boston Elevated Street Railway company; capital stock, $25,000,000, of which $2,000,000 is to be paid in before work is begun. The bill provides for the construction of an elevated double track road from Causeway street to Scollay square, either through existing streets or over land to be acquired by the company; thence along Tremont street to Shawmut avenue; from the junction of these two streets to Dudley street, either over widened streets or through private property; thence it will be extended to Roxbury if it be a success. It is to be operated by electricity. The board of aldermen of Boston is given the power to grant the location from Causeway street to Dudley street. The company is to pay no taxes except those authorized by the state. It is provided that the company may pay 8 per cent. dividends out of its net earnings, but one-half of all above 8 per cent. shall be paid to the city of Boston. The city has the option after twenty years of purchasing the property. The location is to be determined before December of the current year. The incorporators of the company will be the incorporators of the West End Street Railway company. It is intended that the city shall widen Tremont street from Scollay square to Shawmut avenue at its own expense. This bill will undoubtedly be considerably amended before it passes the Legislature, but it is important as furnishing a ground work for discussion.

Prentiss Cummings appeared for the West End Street Railway company at a hearing before the Legislature on rapid transit recently and detailed the objections his company had found against the operation of cars by storage battery. He said: "The trouble with storage batteries is that they are too heavy and bulky. In Milford only 16-foot cars have been introduced, which were thoroughly tried by the West End company and found wholly useless in a few weeks, becoming only old scrap iron and costing four times their earnings to operate. To have a motor large enough to handle a big West End car would take another car to carry the battery. Some much smaller and more powerful battery must be invented before it will be successful in handling such cars as the West End company uses." Mr. Cummings declared that the Hopedale & Milford Street Railway company was backed by a West Virginia corporation, with a capital stock of $5,000,000, of which $4,999,300 had been contributed in patent rights and personal property leaving only $700, which had been paid in. He said also that its annual statement was a made-up affair and that on the basis of business as reported by them the West End company would require 7,000 cars, costing $28,000,000 and $14,000,000 extra to house them and a total increase of $60,000,000 capital to put it on the same basis as the Milford road so it could use storage battery system. J. C. E

PERSONAL.

William B. Roberts, general manager of the Rockford Electric Manufacturing company, Rockford, Ill., was in Chicago last week.

C. McL. Paine, formerly connected with the New York office of the WESTERN ELECTRICIAN, has assumed the business management of the *Architects' Electrical Bulletin*, New York, a publication issued monthly by the Interior Conduit & Insulation company. Mr. Paine's experience should prove valuable to him in his new position.

B. F. Hamilton, of the Sawyer-Man Electric company, New York, will receive the sympathy of his many friends on the death of his father, E. J. Hamilton. Mr. Hamilton was manager of the real estate department of the Equitable Life Assurance Society, and was for 45 years a member of the Olive Branch Lodge of Odd Fellows, Harlem, N. Y.

T. Ahearn of Ottawa, Ont., was in Chicago last week. Mr. Ahearn was returning from an extensive trip through Mexico, Central and South America. Very little progress has been made in these countrys in electrical work, according to Mr. Ahearn, and the political complications which are constantly occupying the public mind greatly retard industrial development.

NEW INCORPORATIONS.

Atwater General Electric company, Cleveland, O.; capital stock, $14 000; manufacturing electrical apparatus; E. B. Davidson, Cleveland, O.

Rockbridge Hotel & Railway company, Glasgow, Va.; capital stock $200,000; operating hotels, electric or steam railway, water and electric plants.

Canton-Salem Electric company, Canton, O.; capital stock, $30,000; furnishing electricity for light and power purposes; A. A. Thayer, Canton, O.

Houston General Electric company, Houston, Tex., capital stock, $30,000; to manufacture all kinds of electrical apparatus, machinery and supplies; Scott Van Etten, Houston, Tex.

Vergennes Electric company, Vergennes, Vt.; capital stock, $21,000; constructing and maintaining works for the manufacturing, furnishing or selling of heat, light and power by electricity.

Mackay Electric Reciprocating Tool company, Portland, Me.; capital stock, $1,000,000; to manufacture, operate and deal in electric machinery, apparatus, devices, etc.; F. V. Chase, Portland, Me

National Metal & Electrical company, Cleveland, O; capital stock, $25,000; manufacturing and dealing in metal, electrical and mechanical appliances, hardware, etc.; Frank A. Strong, Cleveland, O

Crescent Electric Light company, McKees Rocks, Pa.; capital stock, $25,000; supplying light, heat and power in McKees Rocks, Allegheny county, Pa.; Frank Thompson, 413 Grant street, Pittsburg, Pa.

Berlin Building company, Tacoma, Wash.; capital stock, $115,000; to deal in real estate and to erect buildings; to own and operate elevators, gas and electric light plants, etc; Hudson & Holt, Tacoma, Wash.

Delaware & Schuylkill Railway company, Philadelphia, Pa.; capital stock, $50,000; constructing and operating an electric railway in Philadelphia, Pa; Hugh Mullen, 6942 Keystone street, Tacony, Philadelphia, Pa.

Denver Novelty Works & Manufacturing company, Denver, Colo.; capital stock, $15,000; to manufacture and sell stamps and stencils of rubber, brass, steel, copper, etc.; and also electric goods of all kinds, etc.

Montana Electric company, Butte, Mont.; capital stock, $50,000; to carry on a general electric business, general electric construction business, general electro-plating business, and dealing in electrical machinery.

Gladwyne Electric Railway company, Gladwyne, Pa.; capital stock, $12,000; constructing and operating an electric railway in Lower Merion township, Montgomery county, Pa.; Hugh W. Barrett, Bryn Mawr, Pa.

Allegheny Valley Street Railway company, Parnassus, Pa.; capital stock, $15 000; constructing and operating an electric railway in Westmoreland county from Parnassus to New Kensington, Pa.; John T. Reeves, Beaver Falls, Pa.

Millbury, Sutton & Douglas Electric Railroad company, Millbury, Mass.; capital stock, $200,000; to own, manage, construct and operate an electric railroad to run through the towns of Millbury, Sutton, Manchaug and East Douglas to Douglas.

Electro-Hydrogen Lighter company, Jersey City, N. J.; capital stock, $100,000; to manufacture, purchase, deal in and sell mechanical devices or apparatus for generating heat and light, etc.; Wm. T. Hardenbrook, 103 Potter building, New York, N. Y.

Dundee Rapid Transit company, Dundee, Ill.; capital stock, $50,000; to operate street railways and do general transportation business and furnish light, heat and power, deal in electrical supplies and general manufacturing business; E. C. Hawley, Dundee, Ill.

Citizens' Telephone Company of Quincy, Quincy, Ill.; capital stock, $100,000; to construct and operate a telephone exchange in Quincy, Ill., and between other towns in Illinois, Iowa and Missouri and Quincy; to manufacture and deal in all kinds of electrical goods and supplies; J. F. Carrott, Quincy, Ill.

Indiana Natural & Illuminating Gas company, Indianapolis, Ind.; capital stock, $1,000,000; to prospect, bore and drill for, and to manufacture natural and artificial gas, and to sell and supply same for light, heat and power; and to that end said company may acquire, hold, use and enjoy, sell and mortgage real estate and natural and artificial gas and electrical plants.

Sutton-Steel Electric Manufacturing company, Dallas, Tex.; capital stock, $100,000; manufacturing and selling electrical and other machinery; electrical and other apparatus, appliances, etc.; street railway supplies, and also of placing, constructing, operating or selling ice, water, electric light and power plants and other systems of improvement; N. A. Searcy, Dallas, Tex.

ELECTRIC LIGHTING.

Clyde, O., is negotiating for an electric light plant.

Knoxville, Ill., is to have an electric lighting plant.

An electric light plant is being put in at Franklinville, N. Y.

An addition is to be built to the electric light plant at Wellsville, O.

A company has been formed to build an electric light plant at Redruth, Mich.

The Legislature has authorized Milan, Tenn., to establish an electric light and water works plant.

An electric light plant is to be located at Colebrook, Md. The capacity of the dynamoes will be 600 lights.

The question of establishing an electric light plant for lighting the city of Falmouth, Ky., is being agitated.

A Thomson-Houston electric light plant will be installed in Newark, O. Work will be commenced on the plant at once.

The city council of Hawarden, Ia, has granted a franchise to a company to light the city with electricity and to do commercial lighting.

Baltimore capitalists contemplate putting in an electric light plant at Kennett Square, Pa., with lights extending to West Grove, which is also to be lighted with electricity.

The Edison Electric Light company of New York has been awarded the contract for placing an additional lamp in each block on Fifth avenue, between Waverly place and Fifty-ninth street.

The Pontiac, Ill., Electric Light, Heat & Power company (capital stock, $40,000,) has been incorporated. Henry A. and A. P. Foster and C. M. Hamlin are the proprietors of the enterprise.

Women are beginning to take part in electrical matters in Paris, France. Mesdames Henriette Goulard and E. Garnier Goulard on March 7th addressed a petition to the municipal council, asking for a concession for an electric light scheme on the left bank of the Seine at Paris.

The Neptune Electric company of Asbury Park, N. J., has completed its new building. The company has added a new 600 horse power Corliss engine. The equipment of the plant will be five Thomson-Houston 50 arc machines and four dynamos capable of producing 5,000 incandescent lights.

The Mutual Light company of Alliance, O., is a consolidation of the Alliance Gas Light company, the Mutual Electric Light company and the lighting department of the Alliance Street Railway company of the same place and has the exclusive contract for lighting the city for several years. The company owns a large plant and has in operation 3 boilers, 66 inches by 16 feet, 2 Russell engines, 125 and 150 horse power, 6 arc dynamos, 245 arc lamps and 1 Wood 1,500 light incandescent dynamo. The authorized capital is $150,000, and the officers of the company are Elisha Teeters, president, W. W. Cantine, secretary and treasurer.

ELECTRIC RAILWAYS.

The Nassau Electric Railway company, Brooklyn, N. Y., has been granted franchises for important extensions on its lines.

The Cicero & Proviso, Ill., Electric Railway company will extend its line to Maywood and Melrose, and also in other directions.

The promoters of the forty-mile electric road from Nevada City to Marysville, Cal., have received franchises from both places.

The Mt. Vernon, Pa., Electric Street Railway company, capital stock, $24,000, has been incorporated to build a four mile line.

An electric railway will probably soon be built from Macon, Ga., to the property of the Ocmulgee Land & Improvement company.

The Roanoke Street Railway company, Roanoke, Va., has commenced the work of changing the Salem dummy line into an electrical railroad.

The Baltimore City Passenger Railway company will shortly commence the work of equipping several of its lines for operation by electricity.

The electric railway lines now under construction in Ohio amount to nearly 400 miles in length, for the most part being in the northern section of the state.

The Everett & Snohomish Electric Railroad company has been granted a franchise for the construction of a road running from Marysville, Wash., to Everett via Snohomish.

A bill is pending in the Legislature of Ohio to enlarge the power of electric railway companies, permitting them to carry United States mails, express packages, baggage and freight.

In New Jersey electric street cars which are divided into two compartments have been introduced. A first-class fare is 6 cents, while 5 cents pays for a ride in the ordinary compartment.

The Santa Clara county supervisors have granted a franchise for an electric road in Santa Clara, Cal., from the junction of Delmas avenue and San Fernando street to the narrow gauge depot.

The Common Council of Providence, R. I., has granted the Union Railroad company permission to operate electric lines on several of the streets of the city and a number of extensions have been planned.

An electric line between the two great summer resorts, Camden and Atlantic City, N. J., is proposed. A route has been selected, estimates prepared, capital pledged, and a preliminary organization will soon be made.

The city council of West Duluth, Minn., has passed a resolution instructing the Duluth Street Railway company to put in operation a double track electric street railway on Grand avenue from its present terminus to the eastern village limits.

An enterprise which has been under way for some time and now bids fair to be accomplished is the construction of a boulevard and an electrical railroad between the cities of Baltimore and Washington. At present there are two distinct syndicates moving toward this end. One is composed of capitalists, including Messrs. Widner, Elkins and others, interested in the Philadelphia and Baltimore Traction companies. The other is made up of several companies that intend building electric railroads between points along the route a line from Baltimore to Washington would take. It is proposed to consolidate these lines, filling in the necessary connecting links. The promoters of this project include Baltimore, Boston and New York capitalists. The Traction syndicate is moving quietly in the matter, but has made substantial progress, and has already obtained lines in Washington and Baltimore with which the new road would connect.

MISCELLANEOUS.

The reappearance of the electric carriage on the streets of Chicago last week created almost as much amazement as its first appearance. The carriage was propelled through the principal business streets and attracted attention everywhere.

Lightning played terrible havoc last week in Battle Creek, Mich. L. M. Hardenberg's residence on Upton avenue was struck and damaged $800 by fire. Two other houses and a school house were also damaged by a bolt. All the electric motors of the street car company were badly burned, besides several telephones and electric lights. Many people were prostrated by the shocks.

The application of electricity as a motive for ringing church chimes will shortly be introduced in St. Alphonsus church, Baltimore. An electric key-board having wire-connected with the chimes somewhat resembling that of a piano will be placed in the choir gallery where the operas tor will sit. He will be able to play his ponderous chimes by this plan as easily as the church organ.

A number of capitalists of Butte City, Mont., are planning to utilize the water power of the Big Hole river for operating machinery to generate electricity for all purposes in the city. The Big Hole river is only thirty miles from Butte City, and the fall at the point from where the water would be taken, it is claimed, is sufficient to operate machinery of any dimensions, at an estimated cost of $1,000,000.

"The Bolivian government," said Amos J. Thomas, "recently attempted to establish a telephone line between Lapas and Lake Titicaca, forty-five miles apart. It was torn down and destroyed so frequently by the Indians that the government was compelled to abandon it. The electric light plant in Lapaz was preserved by adopting an ingenious method of overawing the natives. After the plant had been in operation but a few nights it happened that there was an eclipse of the moon. The superstitious Indians believed that the electric light was absorbing or swallowing the moon. They gathered in a large body at one quarter of the town and moved upon the plant to destroy it. It was saved only by the intervention of a large body of troops. The government the next day selected several representative Indians, took them to the power house, shocked them severely, then took them out along the line and shocked them again, and informed them that the electric light was an evil spirit and that they had better leave it alone. Since then they have had no trouble on that score."

TRADE NEWS.

The Nowotny Electric company, Cincinnati, O., manufacturer and dealer in electric light and street railway supplies, has been appointed exclusive agent in Ohio for the Meston alternating fan motors and the Chicago Electric Motor company's direct current fan motors.

The model of the Lundell fan motor embodies a self-oiling and self-aligning bearing. The new design of the fan stand gives the outfit an artistic appearance, and the black japanned finish is proving popular. This new model is a striking exposition of the character of the electrical novelties of the Interior Conduit & Insulation company.

The K. W. rosette and branch block patent of the Bryant Electric company of Bridgeport, Conn., has been sus-

tained by the United States Circuit Court of Massachusetts in the action instituted against the Consolidated Electric Manufacturing company. A permanent injunction was granted and the court ordered an accounting for back royalties and damages.

G. d'Infreville of New York, manufacturer of the wasteless gravity zinc for batteries, last week received an order from the American Telegraph & Telephone company for several thousand of his batteries to be used on long distance lines. On account of increasing business he has decided to move on May 1 to 10 Desbrosses street, New York, where he will double his facilities.

The Edison Manufacturing company, 110 East Twenty-third street, New York, is just at present pushing its iron clad battery and fan motor outfit with considerable success. This motor outfit is known as the "Q" type, and is noiseless, has self-oiling bearings, and is entirely inclosed in an iron-clad case, being provided with a glass window at the rear for regulation of brushes. The workmanship is of the very highest grade.

President H. C. Adams of the Phillips Insulated Wire company of New York last week closed a contract for the wiring of a 400 arc light plant of the Fort Wayne Electric company's system with the town of Gravesend, Kings county, N. Y. The "O K." weatherproof wire will be used throughout the whole system. Mr. Adams also has taken an order for several miles of the same wire for the Neptune Electric company of Asbury Park, N. J.

The Case automatic high speed engine is described in an illustrated catalogue which has been recently issued by the manufacturer, the J. T. Case Engine company of New Britain, Conn., which claims for the engines a type of construction permitting of the adoption of the fewest working parts, and these of the highest weight, resulting in the attainment of high speed without injurious vibration. Simplicity and compactness are the points aimed at.

The Ball & Wood company of New York is the first company to have its exhibit complete in machinery hall, at the World's Fair, under the supervision of its engineer, Mr. Wyckoff, and it is already attracting much attention. It consists of two standard simple engines of 150 horse power each; two 150 horse power tandem compound engines, and one 200 horse power cross compound engine. These engines are connected with Brush dynamos. The business of the Ball & Wood company in Chicago will be conducted by W. B. Pearson and Thomas C. Perkins.

The Ansonia Electric company, Chicago, has just sent out to the trade some very handsome plates illustrating special electrical fixtures which this company is introducing. These plates are intended for preservation, in order to aid customers in making future selections, and they are gotten up in very attractive form, handsomely bound and substantial in every respect. The fixtures illustrated are certainly very attractive and they combine many novel features. The company will make a specialty of ornamental fixtures, and it will not only carry a line of standard types, such as those shown in the plates, but it will furnish special designs when preferred.

President George Lockwood of the Fitch Excelsior Switch company of New York is in receipt of many congratulatory letters of recommendation for the automatic switch for electric and cable cars. A. D. Moulton, general manager of the Steinway Railway company of Steinway, L. I., says that after a thorough and exhaustive trial in all kinds of weather during the last two weeks, he is perfectly satisfied with the working of the switch. "It does its work surely and with perfect ease. It is remarkable for its simplicity of construction and ease with which it does its work. I fully recommend it to any one desiring the best switch in the market."

The Ansonia Electric company of Chicago has furnished an expensive suite of rooms at the company's headquarters, corner of Michigan avenue and Randolph street, for the benefit of its friends and customers during the World's Fair. These rooms will be supplied with all conveniences, including telephone and messenger service. Carriages may be ordered, theater tickets purchased and appointments made to meet friends in these rooms. A piano will be placed in the ladies' parlor, and gentlemen may amuse themselves in the reading, smoking and writing rooms, or at the pool tables. Letters may be written from dictation by stenographers; a private postoffice will be established, and it is desired by the company that its friends arrange to have their mail received at these rooms. Private lockers in which baggage and other things may be placed, a coat room, and in fact all the conveniences of a modern club room will be at the disposal of the guests. There is no doubt but that this evidence of enterprise on the part of the Ansonia Electric company will be appreciated, as the World's Fair city will certainly be thronged to its fullest capacity until the close of the exposition.

Ampere is the name of a distinguished French physicist and electrician, who at the beginning of the present century enunciated some of the leading principles and theories in electricity. At the Paris Electrical Congress of 1881 the word was adopted as the name for the unit for measuring quantity of electricity. This unit, the most important in all power measurements, has already become familiar and highly useful in all electric light and power work. For this reason the Crocker-Wheeler Electric company, which is doing a large business in the construction of dynamos and motors for all classes of work in which power is the needed element, has established new and enlarged works at a suburb of Newark, N. J., and have name the place Ampere. A railway depot named Ampere has also been established for the company opposite the entrance to the works, on the Montclair branch of the Delaware, Lackawanna & Western railroad, and as hundred of employes are now settling there, the town will undoubtedly soon be one of the busiest industrial centers in New Jersey—as noted for its electrical machinery as Trenton is for pottery. Ampere is directly connected with the Taylor building, No. 39 and 41 Cortlandt street, New York, where the general offices of the Crocker-Wheeler Electric company are located by means of the telegraph and the long distance telephone. It is 11 miles from New York.

BUSINESS.

It would be of advantage to those who use lubricating preparations to any extent to peruse the book recently published by the Joseph Dixon Crucible company, Jersey City, N. J., advertising its Ticonderoga flake graphite. The company claims for this substance that it is unexcelled for reducing friction in working parts of engines and machinery, and for lessening wear and tear and breakage in joints, gaskets, bolts, etc. The book mentioned, as well as a sample of the graphite, will be mailed upon application.

The Ansonia Electric company, Chicago, announces that from all the large stations into which it has introduced the Wirt indicator it has received additional orders. It has been proven, the company claims, that the use of the Wirt indicator makes a positive saving in lamp bills, which in many cases will pay for itself in a short time; it is therefore not a luxury but an actual economy. The Wirt dynamo brush made by the same company is also rapidly winning its way into the favor of conservative and careful station managers.

H. W. Knight & Son, of Seneca Falls, N. Y., have made pattern letters and figures for thirty years, and their long experience gives them a firm hold on the trade, and enables them to lead in their line. All their letters are cast, and finished by hand. They constantly have on hand 2,000,000 letters and figures in their stock. Of some of the smaller sizes of which there is a large demand, they have 30,000 finished and ready to ship. This enables them to fill all orders the same day received. Some of their hair line letters are so small that it takes 10,000 to weigh a pound, while others weigh 20 pounds each. They have agencies established all over the United States, also in Europe. Address them for their catalogue, drawer 1256.

As has already been announced the three aisles of machinery hall, at the Exposition, are covered by three electric traveling cranes, one in each, the central space being covered by the crane built by the Vale & Towne Manufacturing company. The latter machine has been in constant and active operation, handling heavy materials, and placing exhibits, both day and night, since the middle of December, 1892. Not only has its own intended duty been performed with entire satisfaction, but it has been compelled to assist in the handling of the exhibits and materials for the side arches, pending the completion of the cranes in those aisles. If further proof is needed of the value of electricity as a motive power for traveling cranes, when combined with proper design and workmanship, it is amply afforded by the successful manner in which this crane has performed its functions under the excessively severe duty to which it has been subjected.

ELECTRICAL PATENTS.

Issued April 11, 1893.

495,026. Spool for Electric Coils. George W. Demmick, Lynn, Mass.

495,030. Means for Telegraphing. William H. Fahrney, Chicago, Ill.

495,035. Electric Railway Trolley. Frank Heath, Minneapolis, Minn.

495,038. Multiple Thermal Cut-out. Warren S. Hill, Boston, Mass.

495,046. Electrical Motor. August Knoche, Elberfeld, Germany.

495,047. Electrical Indicator for Rudders. Charles V. Knowles, Somerville, N. J.

495,058. Commutator Connector. Edward D. Priest, Lynn, Mass.

495,071. Compressed Air Apparatus. Elihu Thomson, Swampscott, Mass.

The invention is designed to increase the efficiency of compressed air apparatus. Taking advantage of the fact that air becomes exceedingly cool and its effectiveness as a motive agent is greatly reduced in expanding from the normal temperatures, and that by heating the air before it goes to the motive device it may be worked with greater efficiency, an electric heater is placed in heat conductive relation with the air supply, whereby the air in passing to the motive device is heated to a temperature considerably above the normal.

495,077. Electric Arc Lamp. Addison G. Waterhouse, Hartford, Conn.

495,086. Voltmeter and Ampere Meter. Eugene Gengenbach, Schenectady, N. Y.

The meter comprises a sheet of magnetic material rolled into the form of a cylinder, the sheet having one end broader than the other before rolling, so that after being rolled into the form of a cylinder the length of the surface gradually diminishes in passing around its circumference. Encircling the sides of this cylinder in such a manner that the rolled plate threads through it is a closed loop of magnetic material, which is adapted to rotate about the axis of the cylinder. Surrounding the whole is a solenoid through which passes the current to be measured. The passage of the current induces poles in the coiled plate and in the closed loop, and like poles being at the same end, the loop and plate repel each other, thus causing the loop to move in such a direction that the distance between its inner end and the edge of the rolled plate will be a maximum, which motion is resisted by the tension of a spring.

495,087. Central Office Apparatus and Circuit for Telephone Exchanges. Edward J. Hall, Morris, N. J.

495,090. Granulated Material for Transmitting Telephones. William W. Jacques, Newton, Mass.

The granulated material which is adapted for use in transmitting telephones of the Hunning type has a high microphonic power, that is, ability of the electrodes to move a great distance apart without breaking the contact, and at the same time it possesses a low resistance. The material is formed by coating grains of carbon with powdered alumina and subjecting the coated grains to an intense white heat in an inert atmosphere.

495,107. Electrode for Secondary Batteries. George D. Coleman, Chicago, Ill.

The electrode is formed by blowing or showering finely divided molten lead, or other analogous metal or material within a closed housing, into a suitable mold; the relative distances of the blowing device and the receiving mold being such that the finely divided and molten particles of metal will reach the mold as they are attaining their point of congelation, so that the particles will merely weld together at their points of contact to form a coherent mass of great porosity.

495,125. Electro-magnet. Simon H. Stupakoff, Pittsburg, Pa.

To overcome the difficulty caused by the retention of the keeper of an electro-magnet after the exciting current has been removed, due to the residual magnetism, a small strip of magnetic material is interposed between the keeper and the core, the cross section of the strip being such that it is insufficient to convey many of the lines of force, but which acts when the exciting current is withdrawn to furnish a path for most, if not all, of the lines of force due to the residual magnetism, thus causing the keeper to immediately fall away.

495,127. Electric Annunciator System. Edmund R. Wilder, Kansas City, Mo.

495,136. Commutator Brush. Karl Koch, Elsey.

495,138. Magneto-electric Machine. Joseph N. McLeod, Brooklyn, N. Y.

495,139. Magneto-electric Generator. Joseph N. McLeod, Brooklyn, N. Y.

495,148. Electro-mechanical Steam Engine Recording Indicator. Reuben G. Collins, Dollar Bay, Mich.

495,175. Dynamometer. Edgar J. Wood, New York, N. Y.

495,176. Electric Battery. Frank M. Archer, New York, N. Y.

495,177. Electric Battery. Frank M. Archer, New York, N. Y.

495,179. System for Protecting Telephone Apparatus from Lightning. John J. Carty, New York, N. Y.

495,180. Telephone Gauge. John J. Carty, New York, N. Y., and Frank A. Pickernell, Newark, N. J.

495,193. Railway Danger Signal. Arthur W. Berne, New York, N. Y.

495,225. Potential Indicator. George A. Lintner, Minneapolis, Minn.

The potential indicator comprises a solenoid, to the core of which is attached the pointer or index which carries a contact point adapted to make contact with a stationary contact point, when the pointer indicates a pre-determined maximum or minimum potential, thus sounding an alarm.

495,229 System of Electric Conversion. Edwin W. Rice, Jr., Lynn, Mass.

495,240. Incandescent Lamp. George H. Benjamin, New York, N. Y.

The lamp comprises a bulb provided with a neck and a plug adapted to fit in the neck, a wire being wrapped around the plug in a channel provided for the purpose, the ends of the wire protruding from the end of the lamp in order that a current of electricity may be sent through the wire after the plug has been fitted in position to heat the wire and cause a union between the wire and the material of the plug and bulb.

495,287. Electric Alarm Clock. Thomas P. Adams, Rico, Colo.

495,306. Galvanic Battery. Clyde J. Coleman, Chicago, Ill.

495,318. Globe Holder for Arc Lights. Thomas H. Faben, Toledo, O.

495,321. Electric Street Railway Sweeper. John W. Fowler and John Hutton, Brooklyn, N. Y.

495,383. Overhead Contact Device and Switch. Charles J. Van Depoele, Chicago, Ill.

495,394. Machine for Electrically Welding Metals. Charles L. Coffin, Detroit, Mich.

495,443. Traveling Contact for Electric Railways. Charles J. Van Depoele, Chicago, Ill.

The trolley supporter carrying the trolley wheel upon its end is pivoted so that it may swing freely around a vertical axis.

495,456. Conduit Electric Railway. William R. De Voe, Shreveport, La.

495,461. Electric Arc Light. Rudolph M. Hunter, Philadelphia, Pa.

The arc lamp is of the form known as search lights, the positive carbon occupying a horizontal position and the negative carbon a position at right angles thereto, the crater formed in the end of the positive carbon furnishing an intense light, which, instead of being directed upon the reflector, is directed upon condensing lens, which bends the rays to a parallel or nearly parallel position before projecting them. The changing of the direction of the beam of light, instead of being accomplished by moving the whole lamp upon a ball and socket bearing, is effected by shifting the position of the condensing lens, changing its angularity with relation to the rays emanating from the crater, and consequently shifting the direction of the rays projected from the condensing lens.

495,463. Electric Arc Lamp Carbon. George M. Lane, Asbury Park, N. J.

The carbon electrodes comprise two carbon pencils united by a web of carbon, the whole being formed in one mold. One of the pencils is made somewhat longer than the other, the arc being first formed between the longer pencils of the pair of electrodes. When the arc has sufficiently consumed this pencil it becomes shorter than the second pencil, and the arc gradually shifts by means of the web to the second pencil, thus establishing the arc through the second pencil. The shifting of the arc takes place from time to time as the lengths of the pencils change, thus furnishing a carbon electrode of long life.

495,467. Incandescent Lamp. Henry Green, Hartford, Conn.

Eugene F. Phillips, Prest. W. A. Hathaway, Treas. W. H. Sawyer, Sec'y.

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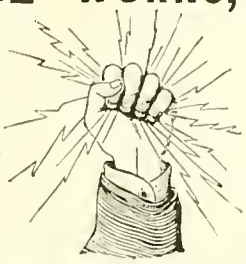

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MONTREAL BRANCH, Eugene F. Phillips' Electrical Works

REMOVAL.

On or about April 15, 1893, we shall move our offices and general business address to 39 and 41 Cortlandt St. The factory will also be moved to our new property at Ampere (East Orange), N. J., D. L. & W. R. R.

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Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY and MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

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Sixty No. 16 Brush Arc Lamps.

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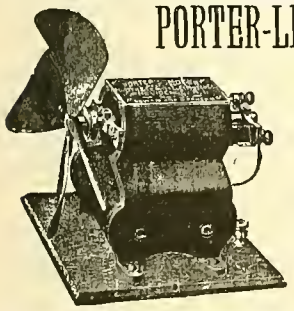

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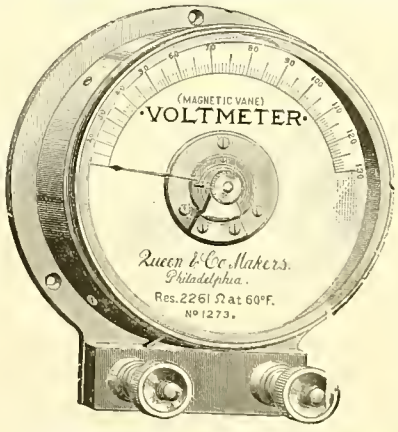

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Very truly yours,
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The Highest Grade of INSULATED WIRE Ever Manufactured.

Has no equal where high voltage, high insulation or durability are required, and is especially adapted for all electric light service, wiring buildings, installing electrical stations, also for underground and submarine work.

Send for and thoroughly examine our samples; bend them, twist them, subject them to acids, oils, gases, or any of the reasonable tests usually applied; note the results; if our claims have been sustained, send to us or our agents sample order. The wire will do the rest.

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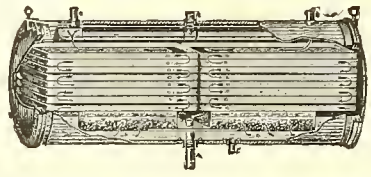

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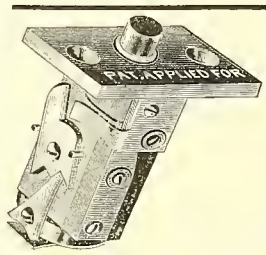

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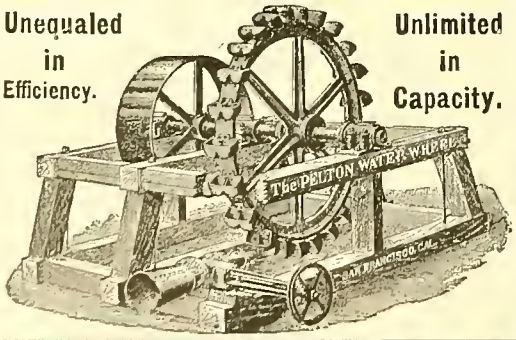

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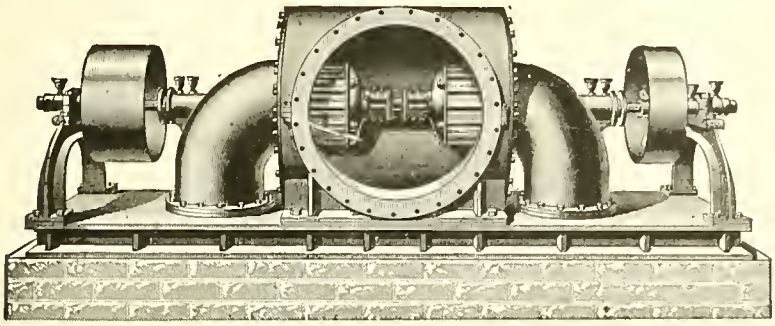

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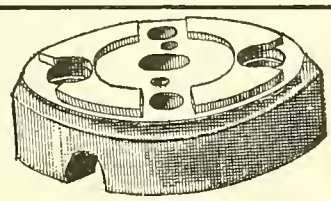

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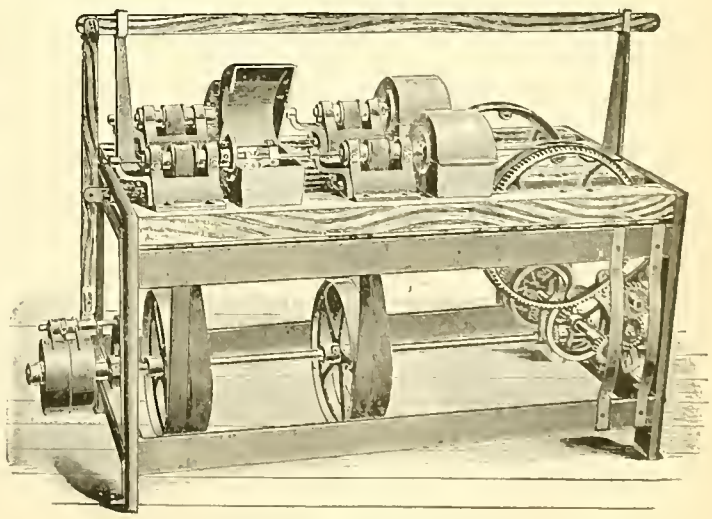

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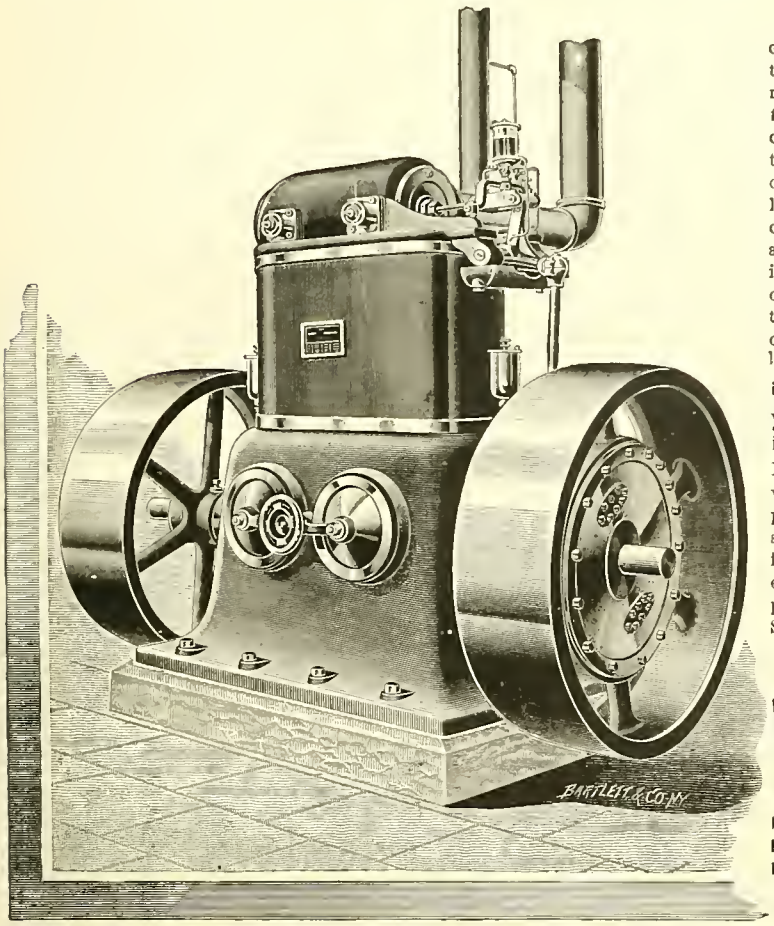

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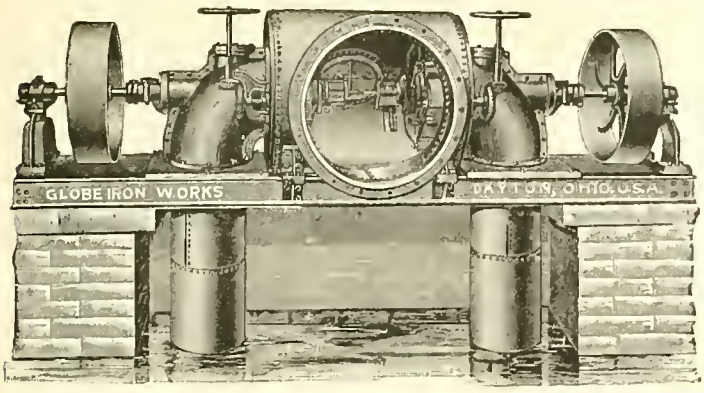

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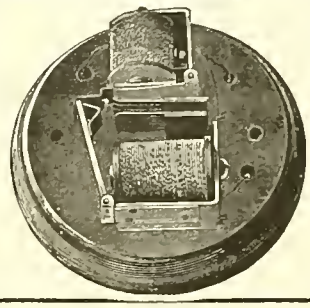

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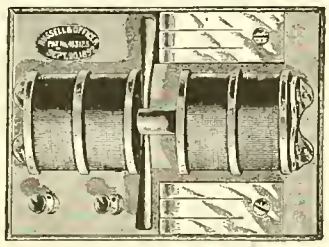

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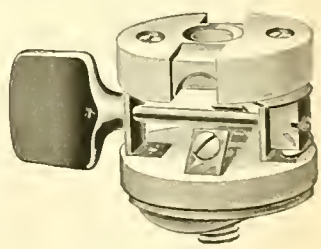

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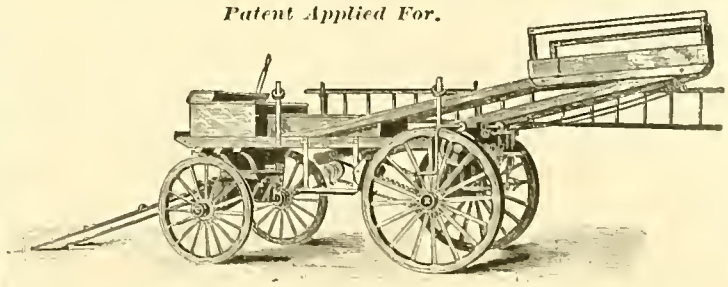

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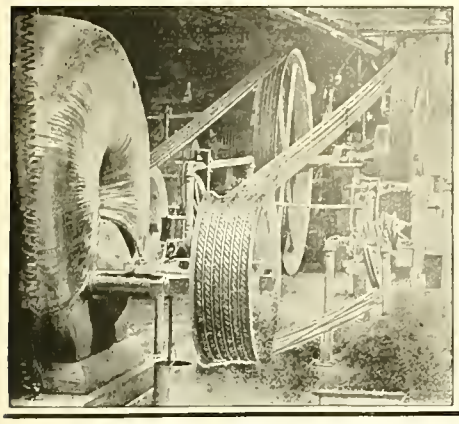

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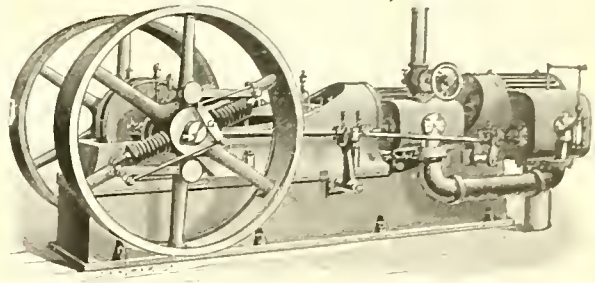

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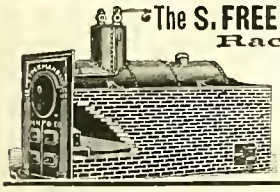

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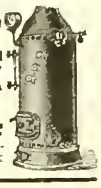

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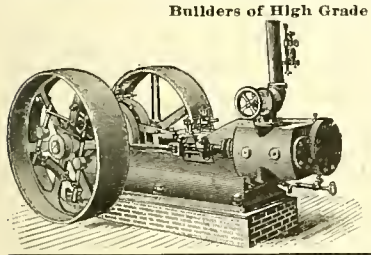

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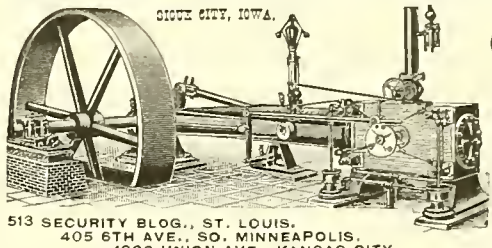

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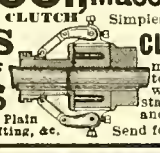

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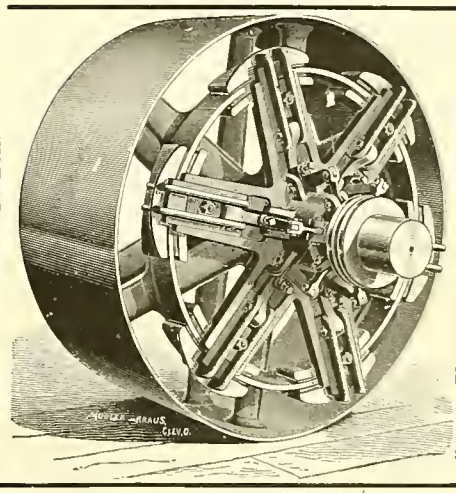

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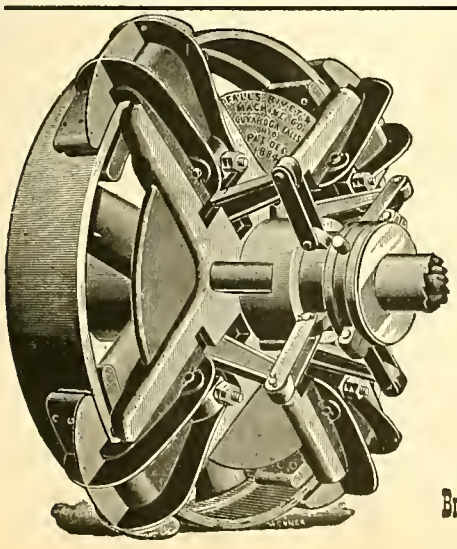

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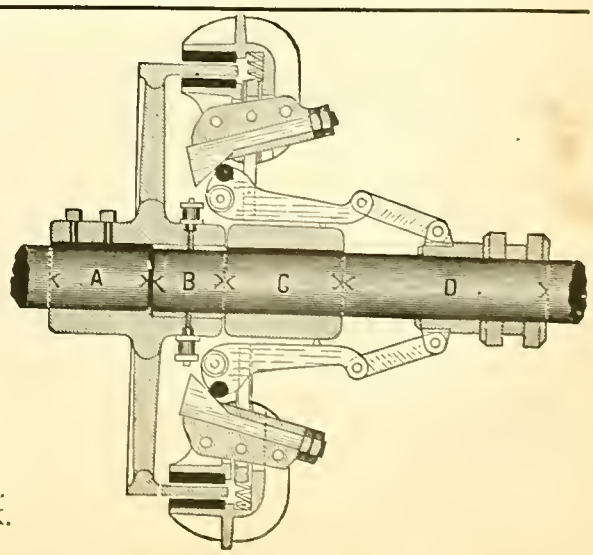

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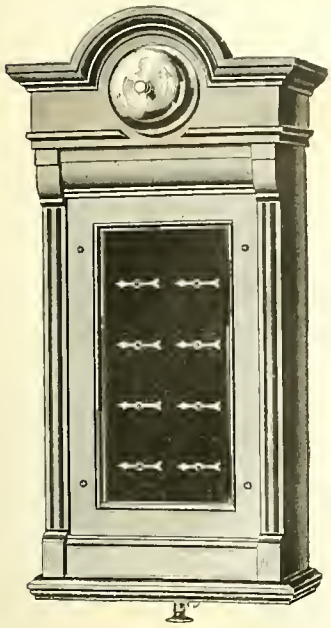

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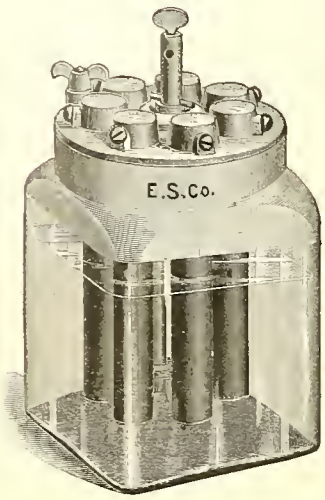

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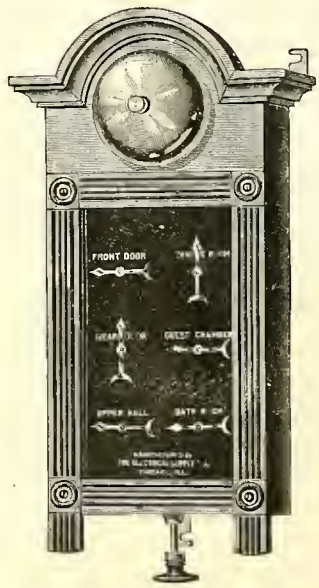

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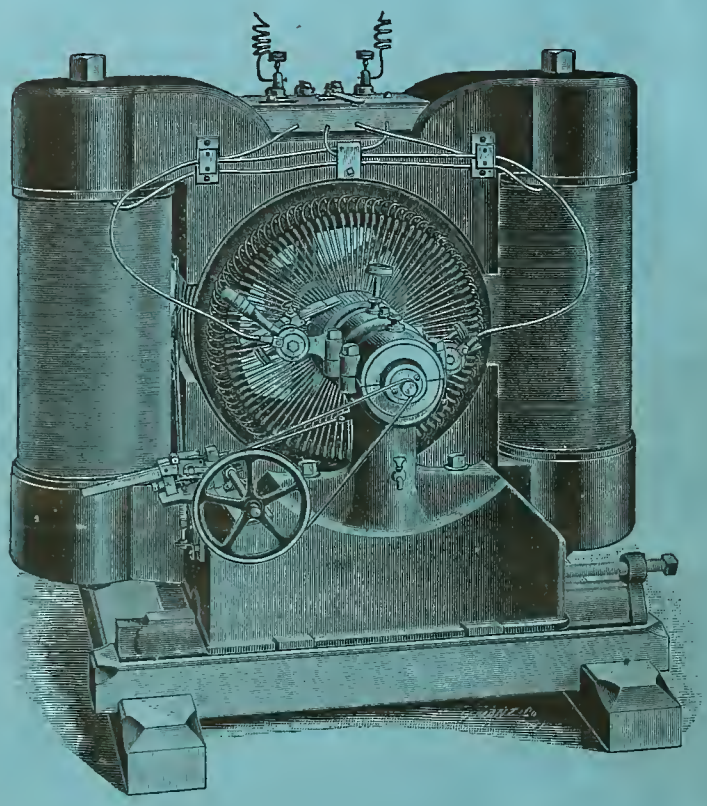

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Western Electrician.

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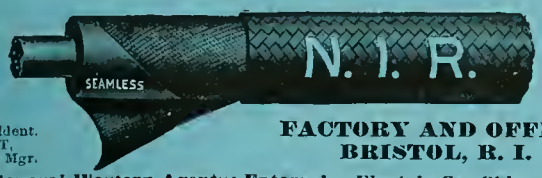

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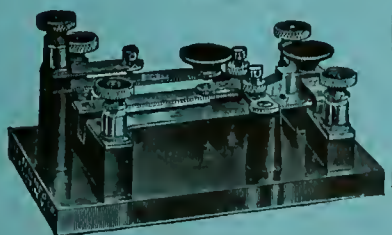

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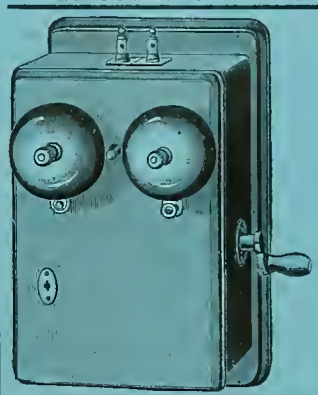

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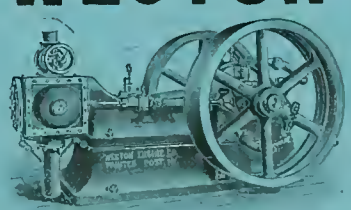

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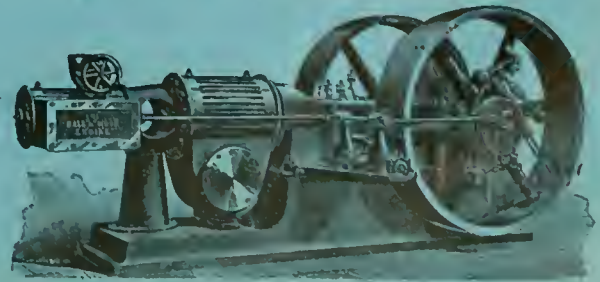

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Jewell Belting Co.
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Delaware Hard Fibre Co.
Goodyear Hard Rubber & The India Rubber Comb Co.
Newton Rubber Co.

Insulators and Insulating Materials.
Ansonia Electric Co., The.
Brookfield, Wm.
Bryant Electric Co.
Butler Hard Rubber Co.
Chicago Insulated Wire Co.
Electric Eng. & Supply Co.
Empire China Works.
Enterprise Electric Co.
General Electric Co.
Goonyear Hard Rubber & The India Rubber Comb Co.
Hart & Hegeman Mfg. Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
International Okonite Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Knapp Electrical Works.
Moore, Alfred F.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Standard Paint Co.
Vulcanized Fibre Co.

Insulated Wires and Cables—Magnet Wire.
American Electrical Works.
Ansonia Electric Co., The.
Bishop Gutta Percha Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent In. Wire & Cable Co.
Cushing & Morse.
Cutter, Geo.
Eastern Electric Cable Co.
Electric Appliance Co.
Enterprise Electric Co.
General Electric Co.
Goodyear Hard Rubber & The India Rubber Comb Co.
Great Western Mfg. Co.
Holmes, Booth & Haydens.
International Okonite Co.
Knapp Electrical Works.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Roebling's Son's Co., J. A.
Shawmut Fuse Wire Co.
Sperry El. Mining Mach. Co.
Waddell-Entz Company.
Washburn & Moen Mfg. Co.
Western Electric Co.

Lamps, Incandescent.
Ansonia Electric Co., The.
Bernstein Electric Co.
Central Electric Co.
Edison Miniature Lamp Dept.
Electrical Eng. & Supply Co.
General Electric Co.
Knapp Electrical Works.
Mather Electric Co.
New York and Ohio Co.
Sawyer-Man Electric Co.
Star Electric Lamp Co.
Steuben Lamp Works.

Lathes.
Bridgeport Machine Tool Wks.
Shepard, H. L.

Lightning Arresters.
Knapp Electrical Works.

Magnet Wire
(See Insulated Wires.)

Mechanical Machinery.
Bridgeport Mach. Tool Wks.

Medical Batteries.
Law Battery Co.
Partrick & Carter Co.

Men.
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

Mining Apparatus, Elec
General Electric Co.
Great Western Mfg. Co.
Sperry El. Mining Mach. Co.
Westinghouse El. & Mfg. Co.

Motors.
Ansonia Electric Co.
Brush Electric Co.
C. & C. Electric Motor Co.
Calumet El. Mfg. & Eng. Co.
Commercial Electric Co.
Crocker-Wheeler Electric Co.
Eddy Electric Mfg. Co.
Elec. Eng. & Sup. Co., The.
Ford-Washburn Storel. Co.
Fort Wayne Electric Co.
General Electric Co.
Great Western Mfg. Co.
Interior Conduit & Insu. Co.
Mather Electric Co.
Nowotny Electric Co.
Porter-Leavitt El. Motor Co.
Rockford Electric Mfg. Co.
Sioux City E. S. Co.
Waddell-Entz Company.
Westinghouse El. & Mfg. Co.

Oils.
Clarendon Oil & Refg. Co.

Oil Filters.
Acme Filter Co.

Paints.
Standard Paint Co.

Patents.
Paine & Ladd.
Rosenbaum, Wm. A.

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Central Electric Co.
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Siebert, G.

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Bristols Mfg. Co.

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Electrician Publishing Co

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Ansonia Electric Co.
Central Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Union Hardware Co.
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Carpenter En. Rheostat Co.

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Klipstein, A.
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Boston Braid Mfg. Co.

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Ostrander & Co., W. R.
Partrick & Carter Co.
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Queen & Co., Incorp.
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Steam Pumps.
Worthington, Henry R.

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Brill, J. G. Co.

Street Ry Tower Wagon.
Davis, W. S. & Son.

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American Electrical Works.
Ansonia Electric Co., The.
Central Electric Co.
Crescent In. Wire & Cable Co.
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International Okonite Co.
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New York Insulated Wire Co.
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Knapp Electrical Works.
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Western Electric Co.

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Marcus, W. N.

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Central Electric Co.
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Knapp Electrical Works.
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New Prices given on Lamps, Street Fixtures, Bank Boards, Series Sockets, Poles, Meters

And all accessories for the use of SERIES LAMPS on ALTERNATING CURRENT DYNAMOS.

This system permits a PROFITABLE and SATISFACTORY method of street illumination and should be investigated by every plant using alternating current apparatus. WRITE FOR FURTHER PARTICULARS AND PRICES.

OUR SERIES LAMPS

Will show you a COMPARATIVE SAVING equal to their FIRST COST in POWER CONSUMED.

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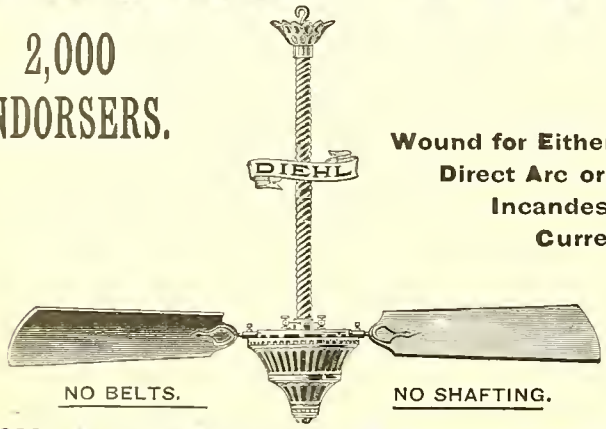

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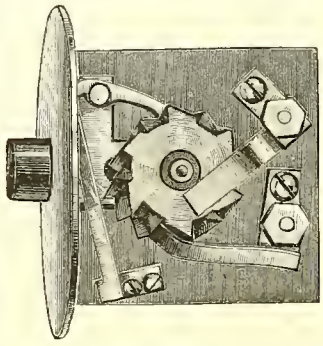

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Awarded the first prize gold medal at the Second Annual Industrial Exposition held at Denver, March, 1893. The only one-push button Switch in the market. If the light is out it turns it on, and if the light is on, push the same button and it turns it out. We make this Switch single pole, double pole, and 3-wire. This Switch is more practical and cheaper than any other push button Switch in the market. It does not need the aid of batteries, a shunt current or other cumbersome adjuncts.

PRICE, 10 Ampere, Single Pole, $1.50.

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INSULATED WIRES OF ALL KINDS.

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Weatherproof Wire.
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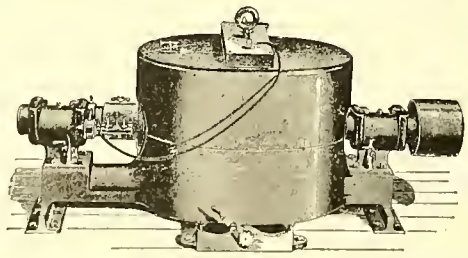
THE Rockford Iron-Clad Motor.



Simple and Reliable,
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For Light or Power.

ROCKFORD ELECTRIC MANUFACTURING CO.,

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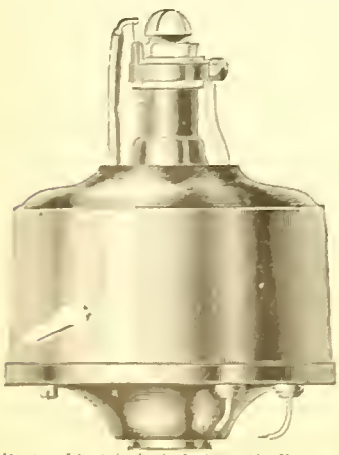
MANUFACTURERS OF THE

Original Celebrated Boston Burners.

HEADQUARTERS FOR

GAS LIGHTING APPARATUS.

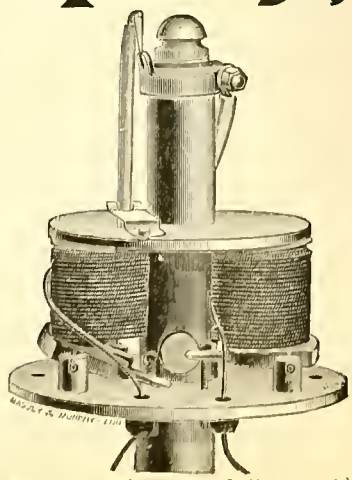
Please do not confuse our name with others.



Boston Electric Co.'s Automatic Burner.

We have the largest and most complete stock of Gas Lighting apparatus to be found in this country. Our burners have proven, by practical use, to be far superior to any others on the market, and our prices are exceedingly low.

Buy burners made by the BOSTON ELECTRIC CO., and get the best. You will thereby save the profits of your labor, besides giving your customers perfect satisfaction.



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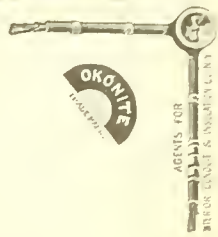

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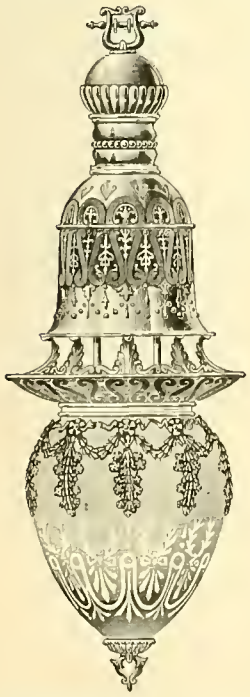
For Low Tension, Continuous Current Circuits.



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Soft, Steady Light; Small Size and Weight; Simplicity; Quick Trimming; Thorough Insulation and Safety; Reliability; Large Range of Amperage and Voltage; Longest Life.

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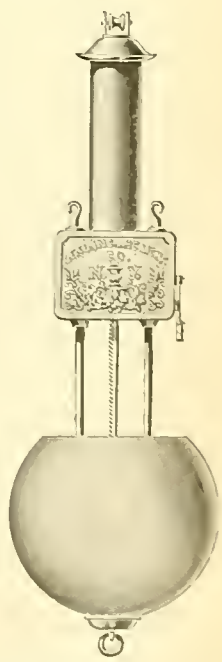
Sent on application, with discounts, etc.

Can be used Singly or from 2 to 12 in series on from 50 to 500 Volts.

All Lamps exactly alike in Mechanism.
No Adjustment or Regulation needed.
Can be Trimmed without touching the globe.
No Dash Pot to hide primary defects.

Our Lamp is absolutely Reliable and will not change from use.

Special Designs and Estimates furnished on demand.



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GENERAL INCANDESCENT ARC LIGHT COMPANY,

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Telephone No. 163 Cortlandt.

SHOWROOMS, 275 Fifth Avenue.
Telephone No. 1459, 38th St.

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DIRECT CURRENT VOLTMETERS AND AMMETERS

Are used in all parts of the civilized world. They are recognized by all authorities as the very best instruments ever produced.

During the past year Mr. Weston has given much time to the further study and improvement of these instruments, and has brought them to a higher degree of permanency, durability, accuracy and excellence than we ever thought possible. ***The New Model*** is the same in external appearance as the old, but is vastly superior to the latter in all that contributes to a first-class instrument. It is the ***acme*** of perfection, and is destined to become and remain

THE STANDARD PORTABLE INSTRUMENT OF THE WORLD.

We have perfected a larger model of these instruments expressly adapted for use as ***absolute standards*** in stations and laboratories. They are designated as the

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The scales are about three times the length of the ordinary portable standards, and the instruments are sufficiently sensitive to work to within 1-75 of one per cent. We confidently recommend them as the most convenient and accurate standards known. They are adapted for the most exact work, and will be found thoroughly equal to its requirements.

We make twenty-two ranges of

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These instruments are absolutely permanent and very accurate, and are incomparably superior to any form of hot wire instrument known. They will be found invaluable in securing and maintaining uniformity and economy of operation of alternating current plants. ***We make multipliers for use with these instruments*** to extend their range so as to measure the highest voltage met with on primary circuits.

We also make sixteen different ranges of moderate priced, high grade

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The capacity ranges from 25 amperes to 750 amperes. These instruments are a new type, and are very accurate and well made. The scales are very regular, the instruments very sensitive, thoroughly durable and absolutely permanent, and their indications are not sensibly affected by the most powerful external fields.

In addition we are making a full line of Direct Current

Station and Isolated Plant Voltmeters,

In three sizes and many ranges. These instruments are very dead-beat, and embody many new and valuable features. They are specially adapted for railway and power plants, and are well suited for arc and incandescent light circuits, and all other work requiring ***good and thoroughly trustworthy voltmeters.*** They are specially designed for switch-board use. We are also making a large line of high grade

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In ranges from 200 to 5,000 amperes, with absolutely proportional scales throughout the entire range. The sensibility and accuracy of these instruments have never been approached. A 1,200 ampere instrument will indicate, with full load or no load, the turning on or off of a single lamp, and can be read in any part of the scale to one ampere. They are very dead-beat, handsome in design and finish, permanent, durable, well made and moderate in price.

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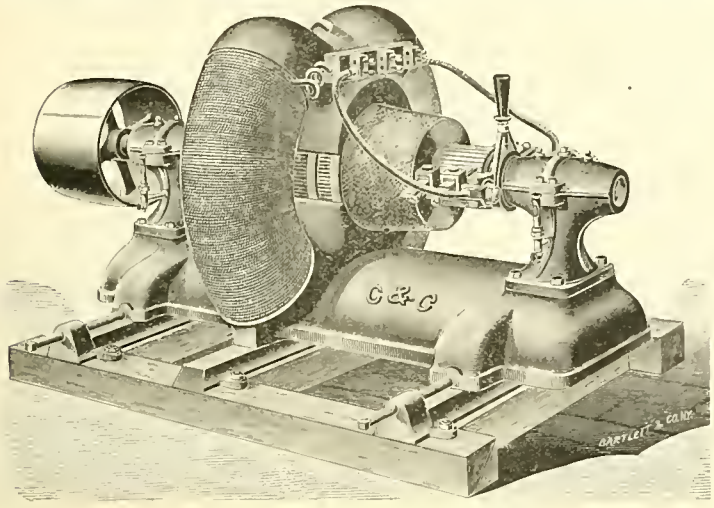

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CHICAGO, 201 Madison St. BOSTON, 63 Oliver St.
Agencies in all principal cities.

Our Individual Arc Light and Motor Cut-Outs

ARE

RELIABLE,

ECONOMICAL,

SIMPLE,

And Require Only One Small Wire.

ELECTRIC SELECTOR & SIGNAL CO.

(Successor to ELECTRIC SECRET SERVICE CO.)

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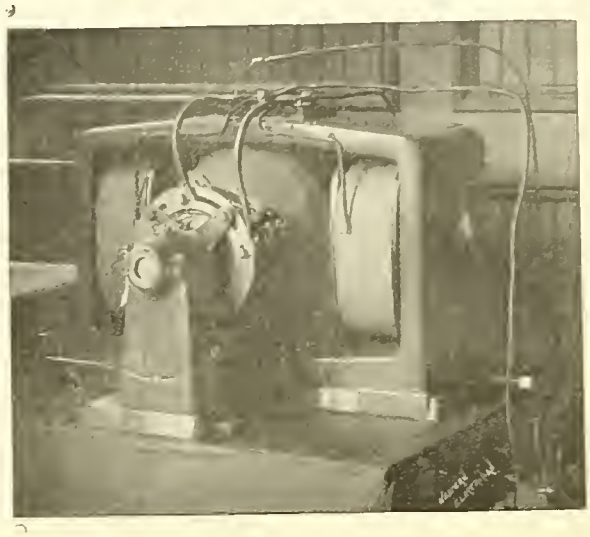

MULTIPOLAR GENERATORS FOR RAILWAY AND POWER PURPOSES.

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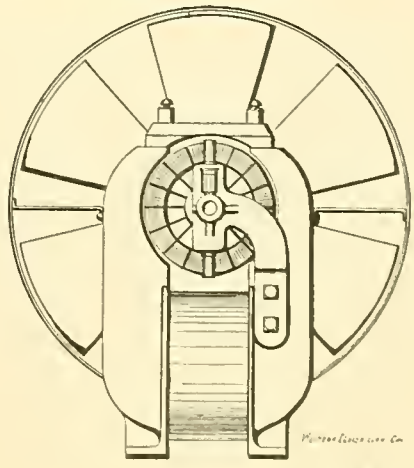
CALUMET FAN MOTORS.

Slow Speed.

Straight Feed Carbon Brushes.

Durable Commutators, with many Segments.



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Direct Current. Back View—Showing Brushes.

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BUILDERS OF THE STANDARD SYSTEM OF ARC LIGHTING.

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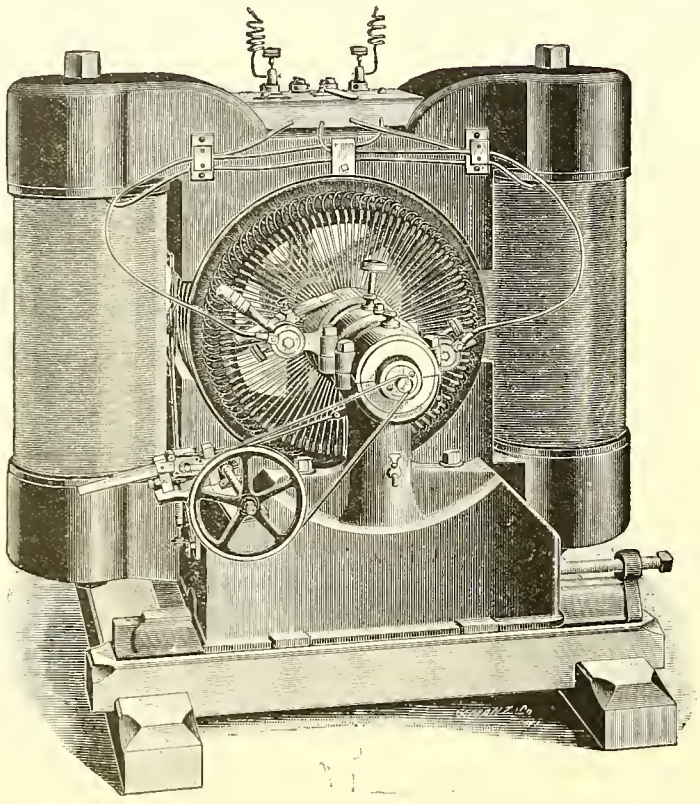

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Central Station Managers, Municipal Officers, Owners of Isolated Lighting Plants and Prospective Purchasers everywhere are invited to inspect and investigate the **STANDARD SYSTEM** before contracting for apparatus.

For lighting stores, foundries, factories or the streets of a city, this system has no equal.

Our contract does not obligate the purchaser to buy apparatus or supplies exclusively of us for a term of years, but courts open competition and encourages fair tests for merit between any and all existing arc lighting systems and the STANDARD.

WHO HANDLES THE GREAT SAMSON BATTERY?

We herewith present some of the leading houses successfully engaged in the work, prominent among which are:—

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CONTRACTORS and FITTERS use the SAMSON BATTERY because it is the BEST and CHEAPEST open-circuit cell made. ASK FOR THE **"SAMSON"** AND ACCEPT NO OTHER.

Respectfully,

THE ELECTRIC GAS LIGHTING CO.,
195 Devonshire Street, BOSTON, MASS.

BOSTON, MAY 1, 1893.

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THE MORRISON STORAGE BATTERY
Is made by the Planté process, no oxides being used, either mechanically or applied in the form of paste, paint or cement.

ELECTROMOTIVE FORCE HIGH; LIFE LONG.

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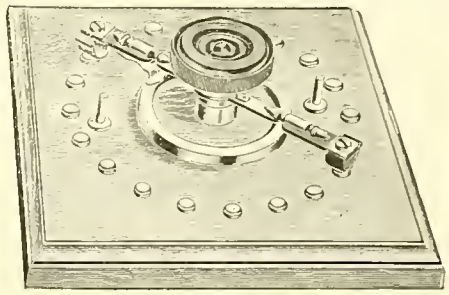
AMERICAN BATTERY COMPANY,
Office: Rooms 23 and 24, 177 La Salle St., CHICAGO, ILL.

VOLTMETER SWITCH.

Are you a Station Manager? If so consider this.



OUR NEW VOLTMETER SWITCH.

This switch enables the attendant to determine the voltage on any of the various circuits diverging from one or more dynamos.

Particularly Practical for Isolated Plants.

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Electrical Supplies of all Kinds House Goods a Specialty

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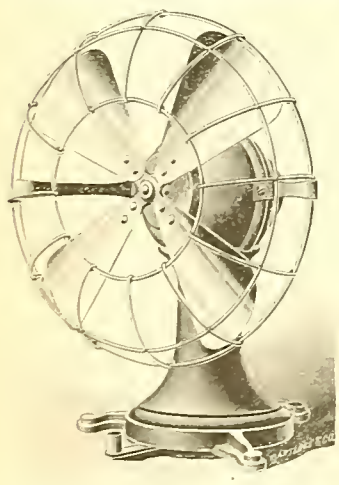

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—AND—

Black Japanned Fans and Guards.

Order now and have a stock on hand ready to supply the demand the first warm day. The **house** with stock secures the **business**.

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E. W. LITTLE, Vice-Pres. and Gen. Mgr.

Only Successful Alternating Current Arc Lamp.

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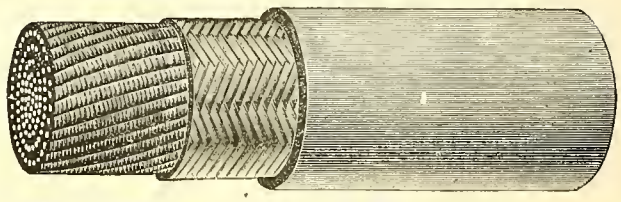

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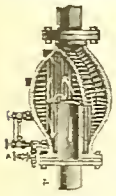

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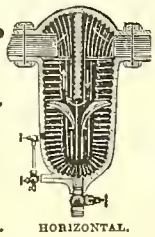

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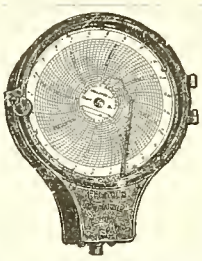

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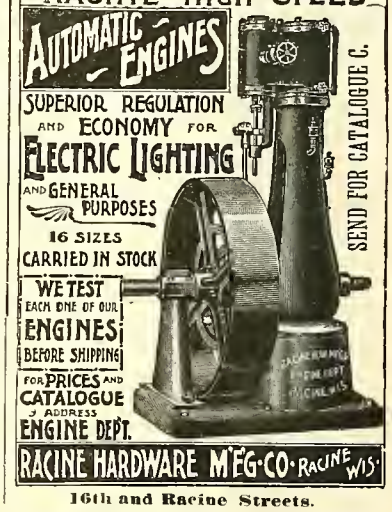

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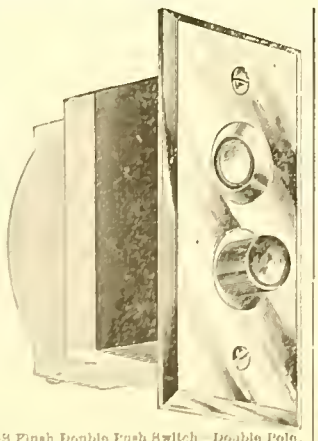

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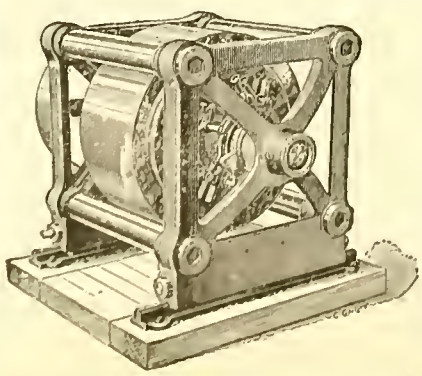

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WORKS AT BRIDGEPORT, CONN.

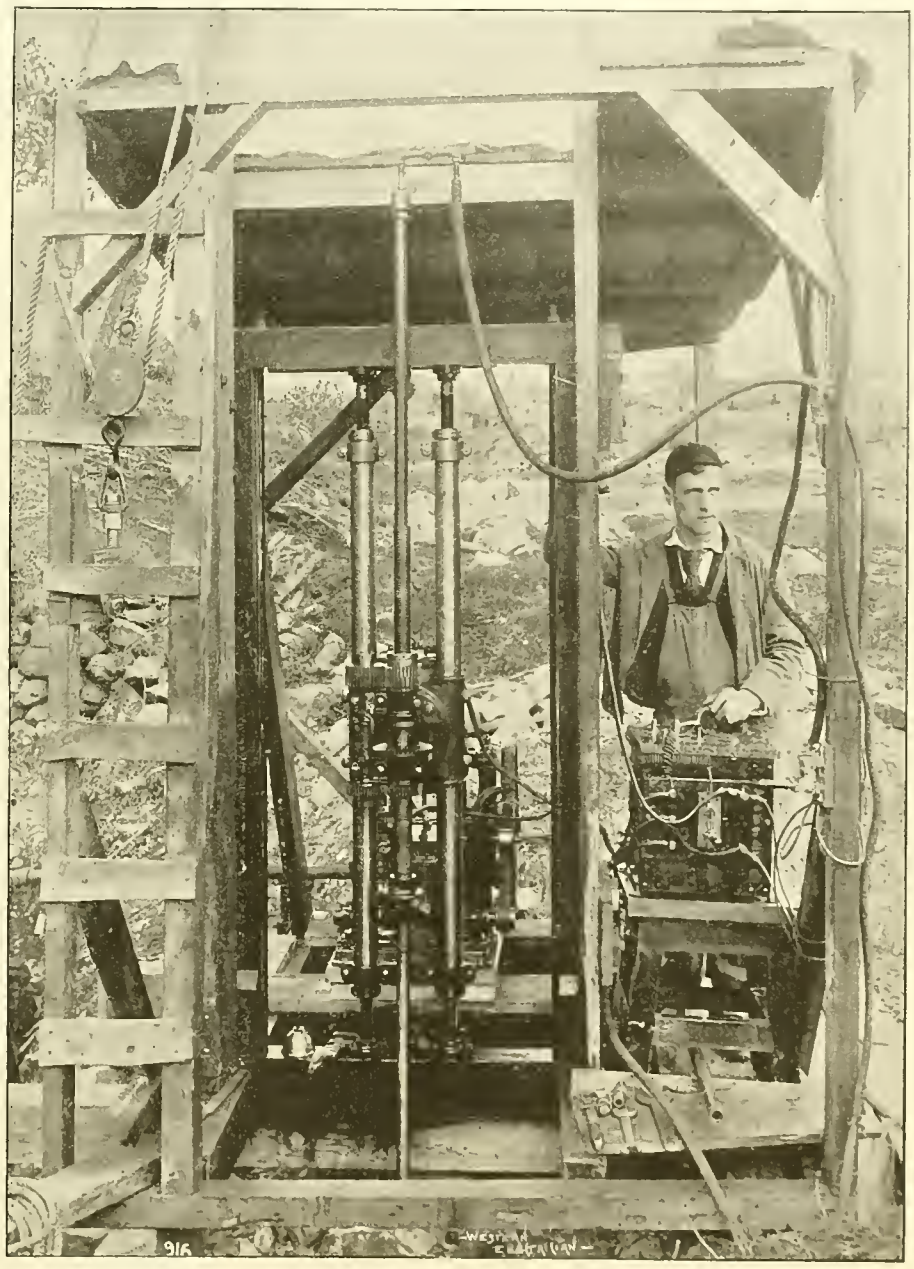
Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, APRIL 29, 1893. No. 17

Electricity at the World's Fair.

As the time approaches for the formal opening of the World's Fair, which is required by law to be made on next Monday, the array of engines and dynamos in the electrical service plant in machinery hall is becoming bewildering. In the arc lighting section the 16 Brush 60 light machines, driven by five Ball & Wood engines, have been installed for some time and have taken care of the temporary arc lighting since the old temporary station south of the transportation building was abandoned. The twenty Standard arc dynamos are now in permanent position, compactly installed in two long lines of ten each, and a portion of the nightly load now carried is thrown on these machines. The Thomson-Houston and Western Electric arc machines are now in the building, and will be ready for operation in a few days. C. & C. and Mather generators are providing current for the power circuits, and the Eddy machines will soon be running. The big Westinghouse plant is well along, and work is proceeding rapidly on the Allis 2,000 horse power quadruple expansion engine that is to drive two of the 10,000 light alternators, belted in tandem. It is this engine and these dynamos that are to be started at an electric signal from the president on Monday. The other big engines of the incandescent section are being put together rapidly, and the work on the directly connected sets is proceeding satisfactorily. The great Westinghouse switch board is nearly completed and several of the other switch boards are in place. There has been some delay on the Edison directly connected 1,000 horse power engine and multipolar dynamos for incandescent lighting in electricity building, and also on the Siemens & Halske lighting set in the German space, due principally, it is claimed, to trouble in getting machinery after it had arrived in carload lots on the grounds. The Fort Wayne and Excelsior arc machines will be running in a week or ten days. The Thomson-Houston and Brush dynamos are painted white and it is said that all the machines will ultimately be of this color. On the whole, the plant is well advanced. It will take care of all demands made upon it from the first day.



ELECTRICITY AT THE WORLD'S FAIR.

The five coronas have been successfully hoisted in place in the great dome of the manufactures building. The center one, which is the largest, having a diameter of 75 feet, was built around the clock tower in the center of the building and then hoisted to the position it now occupies, where it is suspended from the trusses by steel ropes. It will sustain 102 arc lamps, and each of the four other coronas will support 78, making 414 in all. Only a portion of the lamps have thus far been wired, but those on three coronas—two at the north and one at the south end—have already been burned, permitting the workmen in the building to work at night. About 150 lamps contributed to the illumination, but the trial was entirely satisfactory, and demonstrated that the big electroliers will be a pronounced success.

Electric mining and pumping machinery will form a conspicuous portion of the General Electric company's exhibit in electricity building. The illustration on this page shows a new diamond prospecting drill, operated by electricity, that will undoubtedly attract considerable attention. The vertical drilling head is driven by an electric motor, to which it is connected by suitable gearing. The drill is fitted with a hydraulic feed, the drilling head being mounted on plunger rods working in pistons, and the arrangement is such that water, under pressure, may be admitted above or below the piston. The motor used is of the two-pole type, controlled by a resistance box, shown at the right in the illustration. The length of the plungers gives a feed of 18 inches before it is necessary to reset the drill rod.

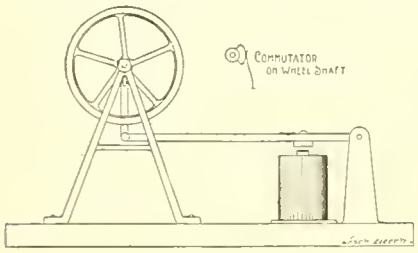
Of the foreign nations exhibiting in the electricity building Germany will undoubtedly make the most extensive display, with France a good second. A number of the German gallery exhibitors were enumerated in the WESTERN ELECTRICIAN last week. To them should be added the Imperial Telegraph department, which will make an elaborate display. On the ground floor, directly under the gallery space are located the firms making heavier exhibits. They are Siemens & Halske, Berlin; Schuckert & Co., Nuremberg; Charles Pollak, Frankfort; Felten & Guilleaume, Muelheim-on-the-Rhine; Allgemeine Elektricitaets Gesellschaft, Berlin; Hartmann & Braun, Frankfort; H. Schomburg & Sons, Berlin.

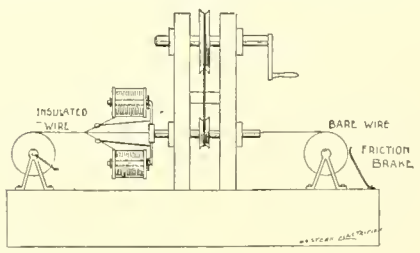
Schuckert & Co., who are represented by Fred W. Tischendoerfer, have 600 square feet of space. The special feature of this firm's exhibit will be immense searchlights. Four of these, Mr. Tischendoerfer says, will be mounted at the four corners of the promenade surmounting the manufactures building. The one on the northwest corner is said to be the largest in the world, being five feet in diameter. Two of the others are four feet in diameter, and one three feet. Three of the big lamps will take 150 amperes of current each, while the smallest one will require 90 amperes. Two of the projectors will be fitted for operation by electric motors and two by hand. In all the carbon feeding apparatus is automatic, and each one is supplied with all improvements for marine use, including signaling devices. The firm will also show three other search-lights in its space in electricity building. Among other Schuckert exhibits will be a combined engine and dynamo for ship lighting, an electric signaling apparatus for communication between the conning tower and engine room of a man-of-war, zinc plates made by electrolysis and photographs of large central stations in Germany equipped with Schuckert apparatus. The firm will also contribute accurate sets of drawings of six of its central station plants for the German engineering exhibit in transportation building.

An attractive exhibit will be that of Felten & Guilleaume, which is in charge of G. A. Schmidt. This firm is one of

the most extensive manufacturers of electric wires and cables in the world. A large and elegant upright showcase, designed after the style of the Renaissance and constructed of expensive woods and plate glass, will be the most conspicuous feature of the display. It will be divided into eleven compartments, one of which will be devoted to the new system of air insulation adopted by this house. Cables and wires of all sorts will be shown in section, and there will also be a large exhibit of house goods. Three large pyramids—one of copper wire, another of iron wire and a third of wire rope—will be conspicuous features.

Of particular interest will be the display of the Allgemeine Elektricitaets Gesellshaft, the principal feature of which will be a scheme for the transmission of power, involving the use of the three-phase current. The first machine in the series is a 200 horse power direct current motor taking current from the 500 volt power circuits supplying electricity building. This motor will be belted to a 100 horse power three-phase multipolar generator. The latter machine, which will be sure to attract much attention, has a periodicity of 50 per second. It has 14 poles and is wound for a potential of 120 volts. It will supply current for a number of multiphase motors, distingnished by the absence of brushes and the fact that the direction of rotation can be instantly reversed. The largest of these motors is rated at 50 horse power and will be directly coupled to a continuous current dynamo; the others will drive pumps, fans and the like. The dynamo last mentioned has a capacity of 300 amperes at 120 volts. It will supply current for 336 16 candle power lamps and a number of small direct current motors ranging from 1-16 to 6 horse power, embracing eight sizes. The lamps will be used for lighting the space and for decorative effects and will also be employed in connection with an elaborate display of stage lighting regulating mechanism. All the parts of incandescent lamps as made in the various





FIGS. 1 AND 2. EDWARD WESTON AND HIS ELECTRICAL WORK.

processes of manufacture in the company's factories in Berlin will be shown, and there will also be nine Allgemeine arc lamps operated on incandescent circuits. In addition there will be a display of electric heating and cooking utensils, a street railway motor and truck, electrically controlled clocks, an electrical device for indicating the time of departure and destination of trains at railway stations, and a number of new measuring instruments. The switchboard will be in the center of the exhibit and will be horizontal instead of vertical. Taken altogether, the Allgemeine company will undoubtedly have the most varied display of any foreign exhibitor in the building. The exhibit is in charge of Jacob Stoetzner.

Hartmann & Brann will make an extensive display of instruments and specialties; Charles Pollak will have an exhibit of secondary batteries, and Schomburg & Soos will show porcelain goods. The principal exhibit of Siemens & Halske will be in the machinery hall, where the firm will have a large directly coupled engine and dynamo, from which it will supply current for lighting the railway terminal station and choral building on the five-wire system. But a pleasing display will also be made in electricity building by this house.

All the German exhibitors are well along with their work, but complain of the delay in delivering cars after their arrival at the park. The criticism of this feature of the exposition management seems to be quite general, and the lack of transportation facilities is largely to blame for whatever delay has been caused in the installation of exhibits.

The Electric Heat Alarm company of Boston will show a complete fire alarm system in the northwestern portion of the gallery of the electricity building. To show the effects of fire the company will heat the bearings of its "journal alarm" by Carpenter electric heaters.

General Manager Mason of the Railway Equipment company of Chicago announces that his company has established a directory of World's Fair visitors interested in the operation of street railways. The office of the Railway Equipment company is in the Pullman building—a convenient location for all visitors going to the park by the Illinois Central railroad.

A large proportion of the electric launches are now at the park. All the boats will make regular trips, and there will be no "cab boats," as was at one time contemplated. The launches will start from the north or main entrance of the agricultural hall. From there they will cross the lagoon to the south door of the manufactures building; thence to the bridge at the southwest corner of manufactures, to the main west entrance and northwest corner of the same building. Going north, the launch turns at the inlet near the fisheries and runs east, stopping at the fisheries bridge and the clambake. Turning and coming back to the lagoon the run takes passengers to the landing before the fine art galleries, swing around the north pond, it comes back to the Illinois building, the womans' transportation, the bridge between the electricity and mines, near the hunters' camp, then to the northeast corner of electricity, then to the southeast corner of the same building and back to the starting point. It is thought from trial trips that the round trip can be made in about 52 minutes at the prescribed rate of speed—about four miles an hour. The speed has been put so low on recommendation of Capt. Symonds, in charge of the marine fleet, because a faster rate of speed might prove dangerous and the wash from the boats might injure the landscape work along the banks. The Electric Launch & Navagation company will have about 200 employes, including 50 boat captains. The awnings and pennants of the fleet are expected to add considerable to the picturesque value of the lagoons in the general landscape effects. The launches will have awnings of orange and red stripes, will fly the regulation United States navy ensign at the stern and the Columbian maritime flag at the bow. The latter, designed by Mr. Millett, has a white ground with an anchor of yellow surrounded by a wreath of the same color.

A party of students from the electrical engineering department of the University of Wisconsin spent a week lately in inspecting electrical plants in and about Chicago under the direction of Prof. Jackson. Six hours were given to the World's Fair, and the embryo engineers gave especial attention to the machinery and electricity buildings. Engines and dynamos of all designs, the giant Allis quadruple expansion engine and the big Westinghouse and Siemens & Halske generators, the electric subways and the exhibits in the transportation building were all briefly looked over.

The Rockford Electric Manufacturing company has shipped its World's Fair exhibit. It consists of a 25 horse power iron-clad motor to be belted direct to a Scott perfecting printing press. This interesting combination will be located in machinery hall, and will be used to print the official daily newspaper. The Rockford Electric Manufacturing company will also have a 40 horse power iron-clad motor in the electricity building in connection with the Standard Electric company's exhibit.

World's Electrical Congress.

A communication has been addressed to Prof. Elisha Gray, chairman of the World's Electrical Congress, by the following representatives of the electrical interests of Chicago: Brush Electric company, S. A. Douglas, district manager; South Side Electric company, W. H. Harding, manager; Western Electric company, C. D. Crandall, manager; Great Western Manufacturing company, H. K. Gilman, business manager; Standard Electric company, D. P. Perry, manager; General Electric company, B. E. Sunny, Western manager; Chicago Arc Light & Power company, C. H. Wilmerding, president; city of Chicago, electrical department, John P. Barrett, superintendent; Chicago Edison company, Samuel Insull, president. The communication, which is dated April 17th, is as follows:

A great deal of confusion is still caused by the term 2,000 candle power, 1,200 candle power, etc., in referring to arc lights. In a good many instances this commercial term has been the cause of litigation between electric light contractors and purchasers of arc light apparatus. We beg to refer in this connection to a few paragraphs taken from Prof. Elihu Thomson's paper read before the National Electric Light association, Providence, R. I., February, 1891.

"It is well known that the value of an arc light for general illumination is greatly enhanced by the fact of the distribution of light being mainly in a downward direction in continuous current arcs. This, of course, follows from the fact of the positive carbon crater being above, such crater being the part from which most of the light comes.

"This matter has been quite thoroughly investigated and

FIG. 6.—EDWARD WESTON AND HIS ELECTRICAL WORK.

many diagrams of distribution are to be found in the literature of the subject, as published from time to time. They show that with the long arc the maximum intensity of light is from 40 degrees to 60 degrees downward from the horizontal and that the horizontal intensity is generally much less than one-half as great, while, of course, the intensity diminishes above the horizontal direction and ultimately becomes zero before reaching the upward vertical direction. In like manner the approach to the downward vertical from the direction of maximum intensity is attended with similar rapid diminution.

"The spherical candle power of arc lights would therefore be only a fraction of the rated candle power which is generally taken at the maximum light obtainable in the best direction from the particular arc or kind of arc in question.

"For this reason the term 2,000 candle power arc has little significance as indicating the illuminating power of an arc. It is now generally taken to mean an arc with ten amperes and not less than 45 volts potential difference between the carbons, or a 450 watt arc. The quality of the carbons will determine whether the 450 watts will be expended in obtaining the most light or not or whether that light will have a maximum intensity at one angle or another within certain limits."

As a matter or fact, all attempts made by purchasers of electric arc apparatus to measure what they usually term the actual candle power of arc lamps have been dismal failures, as there are only a few of the best fitted laboratories in this country in possession of instruments by which they can determine the mean spherical candle power of an arc.

In this connection we would draw attention to an article

FIG. 7. EDWARD WESTON AND HIS ELECTRICAL WORK.

of M. Blondel, which appeared in *L'Industrie Electrique*, an abstract of which was published in the WESTERN ELECTRICIAN, April 15, 1893, from which it is evident that it is absolutely necessary to define the general commercial terms, 2 000 candle power, 1,200 candle power, etc., in practical electrical units.

It is for the reasons stated above that the undersigned ask you to kindly take this question up at the coming Electrical Congress during the World's Columbian Exposition and have the commercial terms mentioned above defined as follows:

"The term 2,000 candle power arc to mean an arc pro-

duced by 10 amperes and 45 volts potential difference between the carbons, or a 450 watt arc. The candle power of arcs produced by currents of more or less amperes or more or fewer volts difference of potential, to be rated proportionally."

Such a definition would at once call a halt to all disputes on this question and would enable every station superintendent, by simply employing a standard ampere meter and a standard voltmeter, to determine whether or not the electric contractor had fulfilled the conditions of his contract as to candle power.

Edward Weston and His Electrical Work.

A story that tells of the efforts of the pioneer in any line of work, whether he be successful, as the world puts it, or, in a sense, a failure, is usually an interesting bit of reading. Men are the same to-day in many respects as they were long ago, and, like the old Romans, they still enjoy hearing of a contest, whether it be a physical or an intellectual one. The early efforts and sacrifices in gaining a part of commercial men to forget that the pioneer cherishes the hope that the child of his brain, if allowed to live at all, shall at least bear his name. Money is a great destroyer of such sentimental distinctions and to-day it is a common thing to see the product of one man's brain paraded under another's name. But happily there still remain a few gifted workers who, through their continuance of valuable original work, compel commerce to make obeisance. Among this class, it is almost needless to say, the name of Edward Weston stands pre-eminent. Only those who know Mr. Weston, or have heard the story of his life in detail, can fully appreciate the patient and valuable investigation along electrical lines that has been carried on under his guidance. To be sure, the factory of the Weston Electrical Instrument company and Mr. Weston's laboratory in Newark, N. J., are monuments to his ability and industry. But even these establishments, representing as they do years of painstaking

FIG. 5. EDWARD WESTON AND HIS ELECTRICAL WORK—VIEWS OF FACTORY.

start, or the struggles of men, who, like Columbus, set sail over unknown seas to discover they know not what, are subjects of interest that catch and hold the attention of thinking men. While it is true that much is learned through failure, it is really the record of the early struggles of the successful pioneer that is of paramount interest to those who take up the broken ends of the chains of investigation that they too may contribute a few links. Electrical men especially appreciate this fact. The difficulties encountered by those patient toilers who with but little to guide and encourage them have cleared the way through a field remarkable for the mystery that surrounded it possess a peculiar interest for the electrical engineer. In this time of consolidations and combinations early electrical work—even the most successful work—is apt to be forgotten. The watchword in this country now seems to be "Advance and forget the Past except where it can be made useful in furthering the commercial interests of the Present." And in pursuing this policy who among the truly scientific workers in the electrical field does not witness with regret the willingness on the brain work and patient investigation, can not be fully appreciated without an intimate knowledge of his work, extending over a period of fully 35 years. Recently a representative of the WESTERN ELECTRICIAN had the pleasure of visiting Mr. Weston, examining his rare collection of books, models and valuable apparatus at his laboratory and library, inspecting his factory and, what was more interesting, listening to the story of the early struggles and trials, as well as the subsequent success and scientific achievements which have crowned the efforts of this remarkable man.

The distinguished inventor and electrical investigator was born May 9, 1850, at Brinn Castle, near Oswestry, in the country of Shropshire, England. His parents were moderately well to-do and owned a farm. His father, however, was skilled in the use of tools and was distinguished throughout the neighborhood as a mechanical genius. Living as he did in a manufacturing town, the boy was brought in contact with men of mechanical tastes and he moved in an atmosphere that tended to develop his inclinations. It was at an early period that he first manifested an interest in all kinds of machinery, and like most boys he soon began the construction of models of steam engines and other machines. His interest, though, in electrical machinery was first awakened in a peculiar manner, which is described by Mr. Weston in an interesting anecdote: "I was between seven and eight years old," said he, "when I was sent one morning on an errand to a drug store. On entering the apothecary shop I noticed on the counter what was to me a very peculiar and mysterious looking box. With natural boyish curiosity, I was immediately attracted and began to investigate. Raising the lid I found within a bar of steel, U-shaped and painted red. At the end of this piece of metal there were pivoted two peculiar looking bobbins. A crank on the outside of the box was connected with these bobbins in such a manner that they could be revolved in front of the U-shaped piece. There were the loose metal cylinders, too, attached to the usual spirals of insulated wire. Of course you recognize the machine, but to me it was a mystery and strongly attracted my boyish fancy. The druggist noticed my childish curiosity, and much amused, gave me the handles to hold. It is needless to say I was willing to do anything to become more intimately acquainted with the curious bit of mechanism so I grasped the metal cylinders with a vim. The crank was turned and I received a shock that I shall never forget. It was the first time—but I can assure you it was not the last—that I had ever received an electric shock, and you may readily imagine the impression made was a lasting one. This, my first experience with electricty, instead of setting my curiosity at rest, aroused it to the highest pitch, and from that day to this the development of the latent possibilities of the electric current have had an irresistible attraction for me."

From that time on electricity became the young amateur's hobby. At the age of nine years he began his reading. Smee's "Elements of Electro-metallurgy" was one of his first books, and not only reading but experimental work along electrical and chemical lines was his favorite employment in leisure hours. Of course he had

a workshop in his parents' house and as a natural consequence his family, like most families that embrace mechanical geniuses, was in constant fear of an explosion or some other equally dreadful accident.

Electro-metallurgical experiments were at first the favorite pursuit, but the young investigator soon drifted into work along other lines. The general design of his first electric motor, built at this early age, is shown in the accompanying illustration, Fig. 1. Mr. Weston seemed to enjoy telling of the manner in which he overcame the numerous difficulties which he encountered in constructing this little motor. "My greatest trouble," said Mr. Weston, "was in obtaining suitable insulated wire. Although the town in which I lived was one of 150,000 inhabitants, there was not one electrical supply store in the place. I was therefore driven to the necessity of insulating my own wire. Of conrse bare copper wire was easily obtainable, but wire with insulation on it was another thing. Perhaps you'll be interested in the construction of this little covering machine, so I will sketch it for you." Suiting the action to the word, Mr. Weston made the little sketch presented herewith in Fig. 2, which is self-explanatory. Continuing

FIG. 4. EDWARD WESTON AND HIS ELECTRICAL WORK.

he said: "It would appear at first sight to anyone not familiar with snch winding machines, that with this little device I conld have done fairly good wor'k with but little trouble. You have no idea, though, how expert I had to become in the manipulation of the two handles to produce wire that was really insulated. You see, unless I moved both handles at certain fixed speeds I left gaps between the convolutions of the cotton. You will, perhaps, be amused when I tell you how I overcame this difficulty. By the use of brown cotton on one spool and white on the other, the instant my windings became irregular I detected the change and could adjust the speed to suit."

Just at this time there was an occurrence which may be taken as illustrative of one of the characteristics of the man as a patient investigator. He was desirous of making a primary battery that would produce results radically

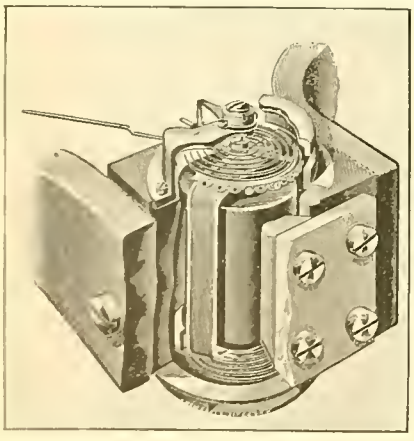


FIG. 5. EDWARD WESTON AND HIS ELECTRICAL WORK.

different from the ordinary form then obtainable. His ambition was to make a Grove or Bunsen cell. The platinum element was of course out of the question. He had therefore to resort to carbon as a positive element, but where to obtain carbon in the form necessary for use in such a battery perplexed him greatly. Nothing daunted, however, he boldly essayed to cut a carbon plate from the rough and tough blocks of carbon which he had obtained from a neighboring gas-works. He first tried to saw his plates from the block, but the hardness of the material prevented the successful accomplishment of this task. Not to be thwarted, however, he actually set to work to chip out from the obdurate material pieces of the required shape and size. After days of patient and persistent toil he at last produced a suitable plate for his battery.

Success in this direction led him to begin the manufacture of electric bells and similar apparatus, and while still a boy he erected a small telegraph line in which the insulators consisted of the necks of glass vials through which the wire was passed.

It was at this time that Mr. Weston became deeply interesting in solving the problem of steam propulsion on common roads. It is interesting to note that even at this early day he suggested the use of rubber tires for avoiding the cutting up of the roads. Experiments, however, along this line were too expensive to permit of his undertaking them.

At 16 years of age, Mr. Weston had accumulated quite a variety of electrical and philosophical apparatus, and it was then that he gave his first public lecture.

The question of a profession for the boy had now become a serious matter with his parents. The youth's tastes naturally tended towards mechanical engineering. Dental surgery was first suggested, and under the guidance of a prominent dentist work along this line was begun, but it was soon discovered that young Weston very much disliked the business, his tastes lying in quite another direction. The parents then decided that he should abandon the career of a dentist and begin the study of medicine. Under the guidance of old Doctor Coleman, a distinguished and kind-hearted physician of the town, Mr. Weston pursued studies more to his liking. Dr. Coleman was a man not only deeply interested in medical science, but in the kindred sciences. Young Weston, as was the custom with medical students at that period, went to live in his preceptor's household. Dr. Coleman had collected quite a large variety of philosophical apparatus, and in his study and under his kindly, yet painstaking and careful guidance, young Weston, in his leisure moments, pursued most enthusiastically, the study of electricity. So much interest did the young student display in what in those days was called "tomfoolery" and of little practical use, that it seemed to his parents that he had not as yet found the calling for which he was best suited. The apparent want of stability on young Weston's part led to considerable trouble with his parents. They, believing in their conservative way, that the boy lacked the faculty of application, pressed him to continue his medical studies. They thought that he had here an opportunity and should stick to it. Matters continued in this way until the young practitioner had an experience that literally scared him into an abandonment of the much disliked profession.

He was called one day to prescribe for a case that was in reality one of typhoid fever, with rheumatic symptoms. With the usual confidence of the young physician, he comp'acently diagnosed the case and prescribed treatment for the rheumatism alone. The typhoid symptoms had not appeared, or at least were not recognized by him and it never occurred to him to look for them. It was needless to say that he had left his patient but a short time, when he was hastily called again by those in charge

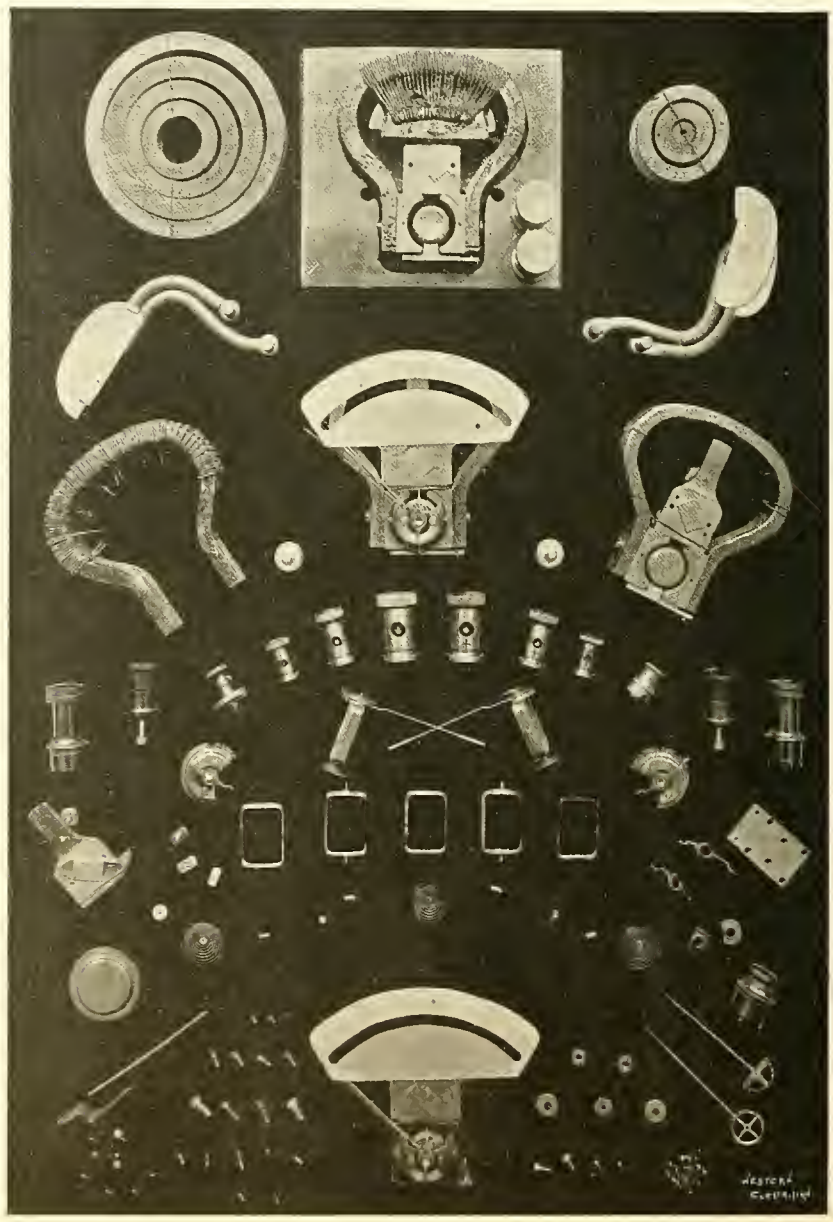


FIG. 8. EDWARD WESTON AND HIS ELECTRICAL WORK.

of the patient, to attend the dying woman. This was too much for young Weston, and, literally scared almost out of his wits, he called to his aid another physician, with whom he was at that time associated, and through their united efforts the patient was finally pulled through.

This was the culminating point in Dr. Weston's medical career. It made him also a little indifferent to the wishes of his parents, and he concluded that he would be less hampered if he struck out for himself. His first thought was to go to London; his second, and the one upon which he acted, was to leave England entirely and visit America. It was some time in the month of May, 1870, that he started for the United States. He arrived in New York with comparatively little money, a few books, and some favorite pieces of apparatus. Armed with a few letters of recommendation from friends at home, he visited

some of the institutions of learning in and around New York. Among others he called upon Prof. Chandler of Columbia College. Prof. Chandler treated him with great consideration and although he procured letters to a number of concerns in New York, the only advice tendered was that he would probably do better in the old country than in the new.

It was through Prof. Chandler's letters, however, that Mr. Weston finally managed to secure a situation as a chemist with a manufacturer of photographic chemicals.

It is somewhat singular that Mr. Weston's course in life was in two cases at least directed by accidents to electrical work. The first of these occurrences has already been recorded; the second was an explosion of chemicals that nearly cost him his life. While with the chemical manufacturer in the basement of a four-story house at 417 Broome street he was engaged in the manufacture of gun-cotton. Through carelessness on the part of a visitor to the establishment, a half-burot match was tossed into a tray of the explosive. Never had the chemist had on hand such a large stock of gun-cotton. Young Weston, luckily uninjured by the first explosion caused by the dropping match, put out the flames before they reached the other trays of gun-cotton. He made up his mind he had seen enough of life as a gun-cotton manufacturer and retired from that position.

He next appeared as chemist and electrician to the American Nickel Plating company, also of New York. While with this concern he devised many important processes that are now commonly used in nickel plating, and it is firmly believed by those of Mr. Weston's friends who are aware of his work in this direction that had he patented all his inventions in the art of nickel-plating he would at this day be the recipient of a princely income from this one source alone.

It was in 1872 that he began the study of the construction of dynamo-electric machines. He entered upon this work primarily with the view of applying the dynamo in electro-metallurgical work. In December of this year he engaged in the nickel-plating business on his own account, and continued in it until 1875. In 1873 he prepared the first copper-coated carbons. It was in this year, too, that he invented his well known dynamo armature; his simple shunt-wound dynamo, designed for constant electromotive force, was under construction at this time. The design of his machine alone, as is now well known by electrical men in general, is such that had he done no other work his name would still live among the designers of the best and most efficient types of dynamos of the day. The close self-regulation of this machine was most remarkable, and was illustrative of the value of careful and scientific construction.

It was in 1875 that Mr. Weston took out his first patent. It was for an improvement in a nickel-plating process, but in this year he gave up the business of nickel-plating and moved to Newark, N. J. Here he formed a copartnership with Messrs. Stevens, Roberts and Havell of Newark for the manufacture of dynamos for electro-plating, electrotyping, electric lighting, and other purposes. It is generally conceded that Mr. Weston was the first man who succeeded in producing a dynamo that would serve satisfactorily for electro-metallurgical work. He employed an ingenious automatic cut-out which prevented a reversal of polarity and consequent change in the direction of current, thus overcoming one of the most serious defects in the machine.

The business grew so rapidly that on July 10, 1877, the Weston Dynamo Machine company was formed to carry on the business with a capital of $200,000. This company, the first of its kind organized in this country, did splendid work in introducing dynamos to do the work that had formerly been performed in electrotyping and plating establishments by batteries. It is interesting to call attention to the fact that now scarcely any electrotyping or plating establishment of any magnitude is run without its own dynamo. In some cases, however, a battery is still used more satisfactorily. Where it is desired to give poor, copper colored gold a richer appearance by coating it with rich yellow gold, a battery is still employed. The reader will have a fuller appreciation of the value of Mr. Weston's improvements in this particular work when it is understood that patents covering certain nickel-plating processes were sold by Mr. Weston for $50,000 to the Weston Malleable Nickel company.

Another interesting fact in connection with the business of the Weston Dynamo Machine company's factory was that even at that early stage of the industry the number of the dynamos turned out frequently reached four per day. The machines were shipped all over the world; in fact it was often remarked that it was somewhat singular that at such an early date a demand should have arisen for such apparatus in countries so remote.

It was about 1875 that Mr. Weston began to deal with the problems relating to the production of light and transmission of power by electricity. A year later he constructed quite a number of incandescent lamps having many features of novelty and great value. Those particularly desirous of learning something of Mr. Weston's work along this line will find a great deal of valuable matter in his discussion of Calvert Townley's paper before the recent St. Louis convention of the National Electric Light association on "The Incandescent Lamp from a Commercial Standpoint." Mr. Weston's address on this occasion was published in the WESTERN ELECTRICIAN of March 18th. One of the most important processes devised in this connection was that of the so called hydrocarbon treatment. Mr. Weston states as a curious fact, that while Mr. Maxim obtained the credit for this invention, and Mr. Sawyer obtained the patent, he was the one who made the invention, and it was, only after a long contest in the Patent Office that he succeeded in establishing his rights. In connection with the arc lamp Mr. Weston devoted a great deal of time to solving the problem of running lamps in series, and it is a question as to whether Mr. Weston was not the first investigator to accomplish this result. To be sure the

(*Continued on page 219.*)

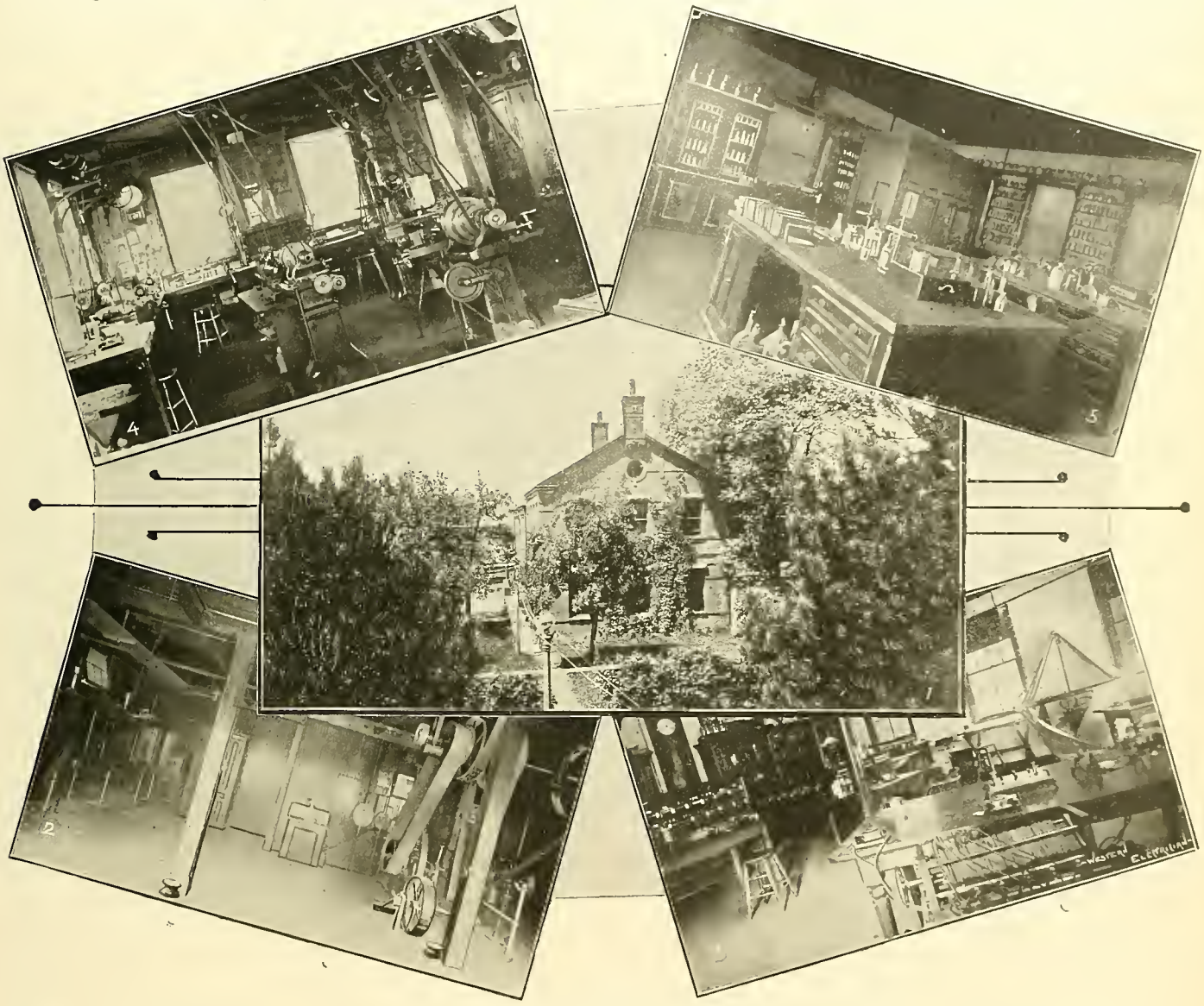


FIG. 9. EDWARD WESTON AND HIS ELECTRICAL WORK—VIEWS OF LABORATORY.

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VISITORS

To the World's Fair are requested to forward their addresses to the WESTERN ELECTRICIAN as early as possible or notify us immediately upon their arrival in Chicago.

FEW men have attained the distinction in the electrical field that has been gained by Edward Weston, whose life and work in the interest of electrical science forms the subject of an interesting and instructive article presented in this issue. Mr. Weston has been an intelligent, patient and persistent investigator and the fame and fortune with which his labor has been rewarded are well deserved. A gentleman of culture and refinement, he wears his honors with becoming modesty. His success is a matter of personal gratification to the entire electrical fraternity.

WE notice in London *Industries* of April 14th an appreciative article on the World's Columbian Exposition. The description, although brief, is fair in spirit, contrasting favorably in this respect with a portion of the foreign press and, unfortunately, a small number of American newspapers. It is accompanied by a double-page supplement giving pictures of the buildings. The cuts are fairly accurate and are only rendered misleading by the fact that the representation of the agricultural building is given as the transportation building, and *vice versa*. Aside from this error, the article is entitled to commendation.

DURING the World's Fair the Chicago Electric club will be called upon to entertain many distinguished visitors attracted to the city by the Exposition and the Electrical Congress. Chicago has a well-earned reputation for hospitality among the electrical people of this country, but never before has the electrical fraternity of the city been confronted with such an undertaking as that presented at the present time. There will be many foreign visitors and to the entertainment of these especially must the club attend, as the organization will be obliged in this instance not only to represent the city but the country. It is certainly fortunate that Chicago has a well-established electrical organization with headquarters suitably arranged for the entertainment of members and guests, and conveniently located in the business center of the city. But clubrooms and furnishings, while very desirable are not the only essential features. Individual effort on the part of every member of the organization will be required and the new management has a right at the present time to expect assistance from every person connected with the electrical interests of the city. The newly elected officers upon whom will fall much of the responsibility of this work are well equipped for their task, all are widely known in the electrical field and they have been prominently identified with the organization. They will receive the support of the retiring officers who will gladly give them whatever assistance experience may afford. This will certainly be a most important year for the electrical interests of Chicago and it ought to be a great year for the Chicago Electric club.

THE communication addressed to Prof. Elisha Gray, as chairman of the World's Electrical Congress committee, by a number of representative Chicago electrical business men, asking that action be taken by the congress to give a more accurate name to the arc lamp now usually spoken of as of "two thousand nominal candle power," is worthy of serious attention. The proposal that the illumioating power of the lamp be designated by the number of watts passing through it certainly points the way to an improvement on the meaningless term now in use; but why can not we have a unit of illuminating strength applicable to both arc and incandescent lighting and capable of easy measurement, without an elaborate series of laboratory demonstrations? Of course incandescent lamps could be compared by the electrical energy consumed, and we might speak of 50 or 55 watt lamps. Then instead of the terms "2,000 candle power arc" and "16 candle power incandescent" we would refer to "450 watt arc" and "50 watt incandescent." But although the latter method would represent with approximate accuracy the relative drafts made on the coal-pile for each lamp, it would not indicate the comparative illuminating power of the lamp, under consideration. In other words it would not be contended that the arc lamp gave no more light than nine of the incandescent lamps, as anyone not well acquainted with the operation of the two systems might infer. It may be urged that the two methods of producing electric light are adapted to divergent uses, and that a common standard of measurement is not necessary. But the two are now used often in conjunction and consumers frequently buy both from the same central station, so that a uniform unit is desirable. What is wanted, then, is an accurate standard of illumination, applicable to arc and incandescent lighting, and capable of commercial measurement.

ADVOCATES of municipal lighting plants and other misguided and misinformed individuals who would invest municipalities with powers that rightfully belong to private corporations should reflect upon the statement of Mayor Gilroy of New York, who, in a recent interview upon a project of this kind, said: "I believe in encouraging private capital. New York city should not enter the field as a competitor in matters that are the legitimate objects of private enterprise. The moment it does it paralyzes private enterprise, it drives out private capital, and makes it seek other cities and other countries for investment." Another reason why such powers should not be given to cities is found in an editorial recently published in the *Chicago Tribune*, which, by the way, has constantly advocated the establishment of city lighting plants to compete with local companies: "As a general rule the operating expenses of an industry run by a municipality are much higher than when a corporation of private individual has the management. Wages paid by a city are higher and more people employed than is necessary. The small economies are never thought of, but they constitute the profits in most businesses. Almost invariably, too, customers are better served by a private company than by a municipality and give it the preference." In this connection the views of C. H. Wilmerding upon the Thiele lighting bill, presented in another column are interesting and instructive. Should the adoption of the Thiele bill by the Illinois Senate be followed up at once by the endorsement of the lower house, there is little hope that Governor Altgeld will veto the measure unless his views on such matters have undergone radical change. In the meantime the representatives of the electric lighting companies throughout the state should oppose its adoption although there is little hope of success. This measure is thoroughly bad in principle; it is antagonistic to legitimate enterprise, and will have a tendency to frighten capitalists who would otherwise invest in electrical work. The bill should be defeated.

JUDGE HALLETT'S decision in the case of the Edison Electric Light company against the Columbia Incandescent Lamp company at St. Louis, last week, was the most important ruling in the lamp litigation since the final decree of Judges Lacombe and Shipman was handed down in the Sawyer-Man case in New York, October 4, 1892. By the terms of that decision, it will be remembered, the Edison incandescent lamp patent was sustained, and the companies making similar lamps, "consisting essentially of a filamentary carbon burner, hermetically sealed in a glass vacuum chamber," were declared infringers. The litigation leading up to and resulting in this decision had been long and costly, and it was at that time generally believed that the incandescent lamp business of the country would be controlled, for a time at least, by the owners of the Edison lamp patent, the General Electric company. That company undoubtedly believed such to be the case, and it was not wholly unwarranted in this assumption, for in following up the case the decision of the Court of Appeals was taken as a precedent in other circuits, and lamp factories in many parts of the country were closed. Very little serious opposition was encountered until the Beacon case came up for a hearing before Judge Colt in Boston. The defendants in this action opposed the granting of the injunction and it was here for the first time that the claims of Henry Goebel were presented. This defense, however, was only partially successful. It delayed for a time the granting of the injunction, but did not prevent Judge Colt from finally issuing the restraining order. It was generally believed that the Goebel claims would be abandoned after the failure of the Beacon defense, but when the trial of the Columbia company's case was reached, it was found that these claims were again to be presented and this time in a much more complete form. The defense had learned through experience in the Beacon case in what particular points the Goebel claims were deficient and it proceeded to fortify itself in these places. So successful was the Columbia company that it secured a substantial victory on Friday, April 21st, when Judge Hallett decided not to grant the injunction asked for by the Edison company. This decision was the first serious set-back the General Electric company had received in its lamp litigation and was least expected at this time owing to the fact that it had already succeeded in defeating the Goebel claims in the Beacon company's case. Judge Hallett evidently anticipated that his decision would be received with some surprise and he looked upon as a departure from the course pursued by judges of other circuits, for he took particular pains in the opinion accompanying his decision to justify his course in this particular. Begining with the Sawyer-Man litigation he says:

It is also contended that the decree of the Circuit Court of New York against the United States Electric Lighting company sustaining the patent, which decree has been affirmed by the Court of Appeals of the Second Circut, is conclusive of complainants' right to the writ for which they now ask. No doubt is entertained as to the conclusive effect of that decree here and elsewhere, as to all matters in issue in that cause. For although respondent was not a party to that litigation, the court would not, on a preliminary motion, consider any matter which passed to judgment in that suit. But the Goebel defense was not made in that suit, and therefore the case was not the authority on this motion which has been ascribed to do it.

Concerning the bearing of the Beacon case in which the Goebel defense was made, the court ruled that there was material difference in the actions:

It is contended that the ruling in that case should be recognized and followed as a precedent in respect to the present motion. And perhaps, if the issue, the testimony and the situation of the parties, appeared to be the same in both cases, such result might follow more from the persuasive effect of the opinion of another court on the same matter than from any notion of authority ascribed to such opinion. In this instance the consequences to flow from diverse opinions are not regarded as serious. In the Massachusetts circuit, and here as well, the motion is interlocutory, and in each case the ruling may well enough stand upon the situation of the parties. And we have much additional testimony to that upon which the court acted in the Beacon case; so that upon all points I do not feel compelled to accept the opinion of the court in that case.

A new factor is introduced in the litigation by this decision of Judge Hallett. It will be necessary for the General Electric company to disprove the statements made in the Goebel case, to prove conclusively that the Goebel lamp was not practicable, and, in fact, to establish once more Mr. Edison's right to the patent upon the incandescent lamp.

Edward Weston and His Electrical Work.

(*Continued from page* 217.)

Jablochkoff candle was run in series, but this device was strictly speaking, not to be considered as an electric lamp. Mr. Weston did excellent work also in the direction of the application of electricity to power transmission. Practical work was done by him as far back as 1876. In 1878 he constructed several electric motors and used them for the purpose of propelling electro-torpedo boats. In fact, even before 1878, he employed motors of one, two and three horse power to do daily service in his factory. An invention of Mr. Weston, which, owing to unfortunate and peculiar circumstances, has not been applied to the extent that it should have been, is one that relates to the preparation of a material called "tamidine." While speaking of this substance Mr. Weston grew enthusiastic. "Tamidine," he said, "I firmly believe is the best substance that has ever been produced from which incandescent lamp filaments can be made. I do not say this egotistically or because I first produced it in a proper condition for its application for this purpose. I make this statement only because I believe it to be a fact." When asked why, if tamidine is the best substance for a lamp filament, it is not used extensively, Mr. Weston explained that owing to complications of a strictly business character this material had not been employed in lamp manufacture to the extent it should have been.

It may be said here for the benefit of those who are not familiar with the nature of tamidine that it is a modification of the substance known as cellulose, which forms the basic principle of most vegetable products. Samples of tamidine made into various forms of lamp filament loops were exhibited at the International Electrical Exhibition of the Franklin Institute at Philadelphia in 1884. The material, too, has found other applications in the arts outside of the one for which it was originally designed.

About the time Mr. Weston commenced the building of dynamos in Newark there was practically no money invested in this line of work in America. The business grew with astonishing rapidity, however, and in 1881 the Weston company consolidated with the United States company of New York. This consolidation led to an increase of capital to $1,500,000. Mr. Weston became electrician of this organization, which was called the United States Electric Lighting company, and under his guidance a large factory was erected at Newark that covered a whole block and gave employment to nearly six hundred hands. He severed his connection with the United States company in July, 1886.

It was but a short time afterward that he started the work of building the present Weston laboratory.

Mr. Weston's first laboratory that was entitled to the name was in the upper floor of his residence on Eighth avenue in Newark. It was here that the most of his experimental work on the hydro-carbon treatment of incandescent lamp carbons, and also the work of designing and developing plating machines and devising electro-plating processes, was done. The next move was to Plane street, where the laboratory occupied the whole lower floor of the Weston residence. All this time, too, the factory was running full blast. This laboratory was devoted exclusively to Mr. Weston's private work. Later on, as electrical industries progressed and more of Mr. Weston's time was demanded at the factory, the laboratory was moved to the works, and it was not long afterward that it became necessary to secure part of an adjoining building as an extension. With these facilities and in these quarters Mr. Weston pursued his work on power transmission problems and continued his investigations along the line of incandescent and arc lighting and other electrical and chemical work. Mr. Weston states that it was in this establishment that the first arc light carbons manufactured for commercial use were made.

When Mr. Weston left the United States company in 1886 and began building his present laboratory, it was with the intention of devoting the rest of his life to experimental work, to the production of inventions, and to purely scientific study. The first line of work undertaken in the new laboratory was upon a complete line of electrical measuring instruments that would be expressly adapted to the use of the practical electrician and electrical engineer. From his long experience in the electrical field, Mr. Weston felt keenly the necessity of simpler instruments than had been heretofore used. With instruments of earlier make there was much labor and many hours lost in making measurements and reducing the readings. One of his first efforts, therefore, was to shorten this time and reduce labor by the production of an instrument to read directly and with accuracy. The present portable standard direct current Weston voltmeters and ammeters were the first commercial results of these laboratory investigations. The factory of the Weston Instrument company at Newark, N. J., in which these instruments are made, is an interesting establishment. A view of the exterior of the works, shown in view No. 1, Fig. 3, will give an idea of the extent of this industry.

FIG. 10. EDWARD WESTON AND HIS ELECTRICAL WORK.

Resembling as it does a watch factory, in so far as the fineness of its product is concerned, it is next to an impossibility to give the reader a thoroughly comprehensive idea of all the details of the work carried on. Of course, a great deal of the work is of the sort that would be more or less familiar to the average mechanic, who had worked on fine machine tools. Thoroughly fitted with the best machine tools of the Brown & Sharpe company, Providence, R. I., the Pratt & Whitney company, Hartford, Conn., and Sloane & Chase, Newark, N. J., as well as a large number of special tools designed by Mr. Weston, the establishment has an equipment of a character that, it is safe to say, is not excelled in any electrical factory in this country or abroad. Some idea may be obtained of the more interesting operations conducted in the factory from the accompanying views. That the reader may the more thoroughly understand what these pictures represent it will be necessary to explain some of the features of the Weston instrument.

In devising his standard instruments, Mr. Weston came to the conclusion that he could not build a satisfactory measuring device embodying soft iron moving parts. He concluded also that the best construction for his instruments would be that in which the magnetic field was one as near as possible to a closed magnetic circuit. Without going further into details it may be said that the present Weston instrument embodies these features. There is but one moving part, Fig. 4. As may be understood from Fig. 5 the air gap is extremely small, so small that it just permits the extremely delicate square coil to swing. It will be noticed that the space within the coil is filled by an iron core. The delicate swinging coil in the larger instruments is made of copper and in the smaller instruments of aluminum. One of the aluminum frames is only .005 inch thick and weighs only three to four grains. An idea of the fineness of the wire on one of these coils may be had when it is understood that it is .009 inch in diameter and costs in the neighborhood of $148 a pound. The permanent magnets employed in the Weston instrument are of course a most important feature. Mr. Weston says that, contrary to a prevailing impression, his instrument magnets are not only aged, but are made as powerful as possible. He further asserts that many are under the impression that the lower the power of a magnet the less is its permanency. His experience, however, has shown him that the stronger the magnet for its size the more permanent is its magnetism. Retardation of the coil's movement is accomplished through the action of the current induced in the little metal frame of the moving coil by the magnetic field. The motion of the coil is opposed by the two spiral springs.

In the instruments now turned out the moving parts are supported in the very best sapphire jewels, made and finished with the same degree of care and skill used on the jewels in the finest watches. The pivots are of hardened steel, ground and highly polished in order to secure and maintain extreme sensitiveness. The aim is to produce a first-class instrument capable of being read to the one-thousandth part of the scale from zero throughout its entire range, and, with fair usage, of maintaining this degree of accuracy unimpared. The most reliable methods of standardizing by direct comparison with certified legal standards are used, thus making these instruments equal, not only to the demands of commercial work, but also to the more rigid requirements of laboratory standards. The instruments are direct reading. No multiplying constant is necessary (except with the high range voltmeters) as a simple inspection of the position of the pointer on the scale gives the value in amperes or volts. Time in making readings is therefore saved, and errors of calculation avoided. All the scale readings begin at zero, and extend by practically uniform increments to the maximum reading. The range is thus greater than is common, while the uniform size of the scale divisions permits of their visual sub-division with uniform accuracy. The instruments are "dead beat." The pointer comes to rest at once, although it is stated that absolutely no friction can be detected, thus reducing the time required for readings, and preventing unnecessary wear of the moving parts; there is no "magnetic lag," giving rise to different deflections with the same current or potential, as in instruments having iron in the moving parts; the temperature correction is negligible, being for the long coil of the voltmeter not greater than one-fourth of one per cent. for a range of 35 degrees above or 35 degrees below 70 degrees Fahrenheit, and for the ammeter less than one per cent. for the same range of temperature.

It is not difficult to understand that a great variety of factory processes must of necessity be carried out before the completed instrument is finally considered fit for shipment. The more interesting of these operations are illustrated herewith.

View 2, in Fig. 3, shows a corner of the factory laboratory in which ammeters of medium range are standardized. Two operators do this work, one calling out the readings of the standard instrument and the other marking the scale. It should be said in this connection that although the scales of the Weston instruments are remarkably uniform, no particular law of deflections is assumed, as must be done when printed or engraved scales are used. Instead, however, a skeleton of each scale is laid out by actual comparison with an accurate standard, and the lines are afterward inked in. Finally, the work is checked by comparison with the same standard.

The current used for this standardizing work is brought from a secondary battery in an adjoining room through heavy copper conductors.

View 3, in Fig. 3, represents a part of the laboratory to

the left and just adjoining that represented in the preceding pictnre. It is here that high reading central station ammeters are calibrated up to a capacity of 10,000 amperes. The method of calibrating these heavy current meters is practically the same as that used in connection with instruments of a lower capacity. The current employed in calibrating is controlled in both processes by specially constructed carbon rheostats. In view 2, of Fig. 3, a rheostat of this sort is clearly shown. It consists essentially of circular carbon plates suspended from metal strips so as normally to hang apart. The contact between these plates, and therefore the resistance of the rheostat, may be changed by a movement of the hand-wheel on a compression screw.

The laboratory proper in the factory is under the management of A O. Benecke, a graduate of the University of Koenigsberg Germany, and for many years identified in Berlin with the manufacture of scientific instruments. Mr. Benecke is assisted by Mr. Lloyd, an electrical engineer from the Lehigh University, and Mr. Hedges. The drawing department is under the direction of M. A. Mueller. Mr. Mueller's connection with Mr. Weston dates back as far as the early days of the electrical business. The general superintendent of the works is L. B. Somerby.

A glimpse showing how three other very interesting operations are carried on is given in view 4, of Fig. 3.

The young lady operative shown at the right in this picture is balancing for all positions what might be called the moving part. This part is shown in detail in Fig. 4 and in position in the magnetic field in Fig. 5. The stand in front of the operator, which carries the part under adjustment, is so devised with universal joints that the part may be tested in any desired position. Tiny screws are inserted to bring the correct balance,

The girl in the center of the pictnre is making a special test to ascertain whether it is correctly balanced for the horizontal position.

The operative at the extreme left is gauging the swinging coil (which constitutes a part of the "moving part") so that its shape will be adjusted with such absolute accuracy that it will move and "clear" the pole-piece faces when it is inserted in its place in the instrument.

In Fig. 6 the workman is forming the little square coil frames. The accuracy with which these must be shaped will be appreciated when the fact is known that in the most delicate Weston instruments the clearance of this swinging coil, of which this frame is an integral part, in its motion between the pole-pieces and the central core is in all .oc9 inch. The finest wire, too, employed on the most delicate coil is .002 inch in diameter. This measurement is of the naked wire without insulation. The wire of this size is about four-fifths the diameter of a human hair.

In Fig. 7 the men are inspecting and testing the jewel bearings used in the instruments. The indicator in the foregronnd will reveal any inaccuracy of the centering of the jewel of 1-11000 of an inch.

In Fig. 8 is presented a view of all the parts of the Weston instrument before assembling.

To leave the reader of the WESTERN ELECTRICIAN without a glimpse of that which is after all dearest to Mr. Weston's heart would be an injustice, besides denying the curious ones a share in the pleasure recently experienced by the writer. Hidden away in the rear of the cosy and homelike Weston residence on High street, Newark, is the present Weston laboratory. It is at the lower end of the lawn, and a glimpse of the picturesque little building is given in the accompanying cut, Fig. 9, view 1. It was in this little eight-room building that Mr. Weston accomplished a great deal of his most excellent work. Entering at the side to the left in the pictnre, the visitor finds himself in the general experimental and power room, view 2, Fig. 9. To the left is clearly shown the photometer that Mr. Weston used for many years during his experimental work on incandescent lamps. Here also are a ten horse power Armington & Sims engine and a Weston five horse power dynamo. These are used with storage batteries for general experimental work.

Adjoining this room, to the left, are two cosy little offices, and on the right, after passing through a tiny boiler room, one finds himself in what Mr. Weston calls his physical laboratory, view 3, Fig. 9.

Upstairs the visitor finds the mechanical department, view 4, Fig. 9, a thoroughly equipped chemical laboratory, view 5, Fig. 9, and a scale room, fitted up with the most delicate balances.

In the machine room, no work of a heavy nature is undertaken, this can be done outside to a greater advantage, but the delicate experimental machine work that is carried on here.

The chemical laboratory is equipped with almost everything that could be required for metallurgical and chemical investigation.

Taken all in all, it may be said that Mr. Weston's cosy little den, if the eight-roomed structure may be so designated, is a place so well equipped for scientific researeh that it would delight the heart of any electrical investigator or other scientific man.

Last, but not least, is the library, which occupies one of the large front rooms in the High street residence. It contains no less than 10,500 volumes. Here it is, as is shown in Fig. 10, that Mr. Weston is seen at his best. In this picture Mr. Weston is shown in company with his associate, R. O. Heinrich, engaged in one of his favorite studies—microscopy.

Mr. Heinrich, it may be stated, is a young scientist of no mean ability, and his work has been and is a valuable aid to Mr. Weston in his instrument investigations. Mr. Heinrich was born in Dresden, Saxony, in 1862, and came to this country in 1884. He received a careful scientific training in Germany and did considerable work as a mining and civil engineer. To acquire a thorough knowledge of electrical engineering he became again a student and took a course along this line at the Lehigh University. After graduating with honors, he first identified himself with Queen & Co., of Philadelphia. Some of the most valuable and best appreciated features of Queen's portable testing sets and various other measuring appliances were devised by him. In 1890 he again engaged in college work as a teacher in the electrical laboratory of his American Alma Mater. The excitement of a business life, however, proved too strong a temptation for him. Having been greatly impressed during a visit with his students to the Weston works with the system there displayed, he made an arrangement through which he represented this concern at the Frankfort Electrical Exhibition. Returning in 1892, after a most successful stay abroad of seven months, he immediately formed a permanent connection with the Weston company. Mr. Heinrich enjoys the entire confidence of Mr. Weston in all business matters and assists him in most of his researches.

The Weston Electrical Instrument company has now agencies in Italy, Austria and Germany; in this country the selling interests of the concern are looked after by Chas. D. Shain.

Chicago Electric Club.

The annual meeting of the Chicago Electric club was held at the club rooms Thursday afternoon, April 20th, at which officers, managers and the committee on membership were elected for the ensuing year. The following named gentlemen were chosen to fill the offices named by a unanimous vote.

President, J. P. Barrett; first vice-president, F. W. Parker; second vice-president, E. Baggot; third vice-president, F. W. Cushing; fourth vice-president, George Cutter; secretary, F. L. Perry; treasurer, J. W. Johnson; managers, F. W. Horne, chairman; L. A. Ferguson, S. A. Douglas, M. A Knapp, J. W. Buckley, E. C. Ferguson, C. T. Page, A. S. Terry, Ben. Williams, L. S. Hills; membership committee, C. C. Haskins, Thomas G Grier, D. G. McDougall.

The new officers were congratulated by those whom they succeeded and by other members. Prof. Barrett on assuming the duties of his new office announced that with the co-operation of the members he believed the new administration could not only keep the organization up to its present excellent standard, but that it could improve and extend the influence of the club. During the present year the club would be called upon to entertain visitors from all parts of the country, and distinguished guests from abroad, and to do this creditably the co-operation of every member would be required. President Barrett concluded his address by expressing his appreciation of the compliment paid him by his associates, and assured them that he would strive to justify the confidence they had expressed in him. At the conclusion of the meeting lunch was served and the remainder of the evening was passed in an informal manner.

The Compagnie des Mines de Vicoigne et de Noeux, France, has invited proposals from the principal electrical firms for an important installation at its mines. The proposals call for the establishment of a central station, which will provide electrical power for the different works throughout the colliery. At present only two dynamos will be put in, the current from which will be utilized at a distance of 4,400 meters for the working of five winding gears of from 6 to 14 horse power. Five pumps operated by electric motors of 5 horse power will be placed at the bottom of the mine, and electric locomotives, each of 12 horse power, will be employed for the conveyance of coal along the principal gallery, which has a length of 2,000 meters. The mine will be illuminated by 26 arc lamps and 200 incandescent lamps, each of 16 candle power. This will be the first installation of its kind in France.

Incandescent Lamp Litigation.

In the United States Circuit Court at St. Louis, April 21st, Judge Hallett handed down his decision on the application of the Edison Electric Light company and others for an injunction against the Columbia Incandescent Lamp company, restraining the latter from manufacturing incandescent lamps. The application was denied. Judge Hallett's decision and the accompanying opinion which are appended were published in an extra issue of the WESTERN ELECTRICIAN immediately after the decree was made. The decision is the first setback which the Edison interests have experienced in the lamp litigation and is certainly an important victory for the Columbia company. Following is the full text of the opinion:

Complainants allege infringement of letters patent No. 223,898, issued to Thomas A. Edison, January 27, 1880, for an improved electric lamp. This patent came under the consideration of the Circuit Court of the Southern district of New York, in the case of the Edison Electric Light company, vs. the United States Electric Lighting company (47 F. R. 454), and was held to be for a lamp "consisting essentially of a filamentary carbon burner, hermetically sealed in a glass vacuum chamber." So understood, it is the incandescent lamp in common use, and no question is presented in this record as to the character of respondents' manufacture. The defense to the bill and to the motion for preliminary injunction now under consideration is want of novelty in the Edison patent. Respondents aver that an incandescent lamp different in form but in all essential features the same as that now in general use was made as early as 1854 by Henry Goebel, of New York city, and that it was used by him in various ways and at different times for many years thereafter. It will not be necessary to describe this lamp at length, as it has the same constituents as the Edison lamp. We are at present more concerned with the struggle between the contending forces, on the one side to maintain and on the other to disprove, the existence and use of the lamp anterior to the date of the Edison invention. A large mass of testimony in the form of affidavits is offered by each party on the question of fact, which, to consider at length, would be a tiresome and unprofitable task.

The principal objection urged by complainant against the Goebel invention is that it has an impossible date; no man could make it in the time and manner assigned to it; the incandescent lamp is the product of several auxiliary arts not likely to fall within the compass of a single mind; as an achievement of science the lamp is a matter of progressive steps, some of which must be made by the world at large before others can be taken by anyone. This is no more than to say that no man can outrun his competitors to any great length in the field of scientific investigation—a proposition which has no support in reason or experience. There seems to be no reason for saying that Goebel could not reach in 1854 the point attained by Edison in 1879, unless, as was said by the dissenting Justices in the telephone cases: "It is regarded as incredible that so great a discovery should have been made by the plain mechanic, and not by an eminent scientist and inventor."

In so far, however, as it may be shown that the methods adopted by Goebel were not equal to the results obtained, the evidence should receive the most careful consideration. On this point it appears that Goebel has recently made several lamps of the form and with the material and tools formerly used by him. These lamps were tested by men of skill and experience in such matters, and they were found to be reasonably effective. They are not so good as the lamps in common use, but they can be operated, and they give reasonable service in time and capacity of light. So that in this way we have prima facie proof of Goebel's ability to make lamps in the way he claims to have made them before the time of Edison's invention.

It is said that Goebel is involved in contradictions and misstatements of facts due to the lapsing memory of old age or to untruthfulness. Be it so; he does not appear to be an adventurer or an imposter. It is not reasonable to believe that he made the story related in his affidavit and did not make the lamp he has described. Whatever may be said as to Goebel's veracity, he is supported at many points by witnesses of good repute who speak with precision and apparently with deliberation. As already suggested, it is not necessary or profitable to go over the testimony at length with a view to determine the relative value and weight of every part. It is enough to say that there is a fair preponderance of testimony in support of the Goebel claim.

There is not the measure of proof demanded by complainants' counsel, who maintain that the Court should require proof of the fact beyond reasonable doubt. This degree of certainty is not often attained upon testimony in the form of affidavits where the issue is contested. And it is not reasonable to demand such certainty as to the defense. Complainants must show a clear right in support of a preliminary writ, and a defense which puts the case in doubt is sufficient to defeat the application. (Goodyear vs. Dunbar. 1 Fisher, 472. Glaenzer et al. vs. Wiederer et al., 33, Fed. Rep., 583. Fraim vs. Sharon Valley Malleable and Gray Iron company, 27 Fed. Rep., 457. Cary vs. Domestic Spring Bed company, 26 Fed. Rep, 38. Robinson on Patents. Sec. 1,171).

It is also contended that the decree of the Circuit Court of New York against the United States Electric Lighting company sustaining the patent, which decree has been affirmed by the Court of Appeals of the Second Circuit, is conclusive of complainants' right to the writ for which they now ask. No doubt is entertained as to the conclusive effect of that decree here and elsewhere, as to all matters in issue in that cause. For although respondent was not

a party to that litigation, the court would not, on a preliminary motion, consider any matter which passed to judgment in that suit. But the Goebel defense was not made in that suit, and therefore the case has not the authority on this motion which has been ascribed to it. (National Hat Pouncing Machine company vs. Hedden et al., 29 Fed Rep. 147. Lockwood vs. Faber, 27 Fed. Rep., 63. The Bailey Wringing Machine Co. vs. F. F. Adams et al., 3d B. & A., 96.)

Another suit by the complainants against the Beacon Vacuum Pump & Electrical company in the Circuit Court of the District of Massachusetts is in a different attitude. In that suit the Goebel defense was made,and upon motion for preliminary injunction recently heard and allowed, it was over ruled. It is contended that the ruling in that case should be recognized and followed as a precedent in respect to the present motion. And perhaps, if the issue, the testimony and the situation of the parties appeared to be the same in both cases, such result might follow more from the persuasive effect of the opinion of another court on the same matter than from any notion of authority ascribed to such opinion. In courts of equal jurisdiction proceeding concurrently in the investigation of the same subject the right and duty of each to exercise independent judgment cannot be denied That they should in the end reach the same result is greatly to be desired, but one cannot become an echo to the other for that praiseworthy purpose. In this instance the consequences to flow from diverse opinions are not regarded as serious. In the Massachusetts Circuit, and here as well, the motion is interlocutory, and in each case the ruling may well enough stand upon the situation of the parties. And we have much additional testimony to that upon which the court acted in the Beacon case; so that upon all points I do not feel compelled to accept the opinion of the court in that case.

The ruling of the court, however, in the Beacon case suggests the propriety of taking security from respondent for observing the decree in case complainants shall ultimately prevail in this suit. There are other considerations also which should have weight in that direction. It was suggested by complainants' counsel that respondent is a concern of small capital, and that it was made so with intent to avoid responsibility in respect to the infringement now alleged against it. This was not denied, and I suppose we may take it to be true. The retort was in the form of a charge against complainant that it used its monopoly of electric lamps to control the sale of all kinds of electrical machinery and apparatus. This charge also passed without denial, and it is not difficult to conceive of circumstances in which it would be necessary to ascertain whether it is true. Referring only to the charge against respondent of sufficient capital and assets, the duty of the court is plain to provide for the contingency of a decision against it. It need not refer to the possible effect of cross-examination in the case of a multitude of witnesses. What now seems plain enough may altogether disappear, and new facts may come to the surface under that crucial test.

The injunction will therefore be refused if the respondents shall give a bond in the sum of $20,000, conditioned for the payment of such sum (if any) as may be decreed in favor of complainants on the final hearing of this case, the bond to be filed with the clerk of the court, and to be approved by the clerk or by a judge of the court, within 20 days from this day.

On Friday afternoon, April 21st, the Columbia Incandescent Lamp company filed a bond in the sum of $20,000, with the clerk of the United States Circuit Court in St. Louis, as required by Judge Hallett's decision. The sureties on the Columbia company's bond were J. H. Rhotehamel, D. E. Garrison and W. O. Garrison. The company has already begun the shipment of lamps, and its works are now in active operation, with an abundance of orders in hand.

The lamp works of the American Electric Manufacturing company, St. Louis, are also being put in shape for immediate resumption of operations. This company expects to begin shipping lamps immediately. The American company closed its factory voluntarily and is, therefore, under no obligation to give bond.

The Brooklyn City & Newtown Railroad company has placed orders for two more directly-coupled generators. The units employed in this station are a 250 horse power generator coupled direct to an 18-30 by 16 Westinghouse compound engine at 250 revolutions. The power staton of this road will contain eight of these generators, of which five are already in place. A single one of these "kodaks" has handled thirty-eight cars over the grades of this road continuously.

In a street car collision at the corner of Tenth and Washington streets, St. Louis, last week, half a dozen people were seriously injured, Two electric cars on the Newton and Bellefontaine road crashed into a horse car of the Northern Central line, and two persons were badly injured about the head and shoulders. They were taken to the hospital. The others were only slightly injured and were removed to their homes. The accident was caused by the neglect of the motorman on the Bellefontaine car to apply the brakes promptly. The Northern Central car had its running gear totally smashed, broken car wheels and pieces of broken axles being strewn right and left.

Two-Phase Alternating Current Motor on Lighting Circuits.

A series of experiments extending over several months has been conducted at Pittsfield, Mass., by the Stanley Electric Manufacturing company with a view of demonstrating the feasibility of operating its two-phase alternating current motors in connection with regular lightning service. Since January 1st, the Stanley company has had in operation at the station of the Pittsfield Electric company one 60 kilowatt two-phase alternating current dynamo, supplying a current over a thin wire system of about two miles in length to 475 lights on thirty transformers, and seven motors ranging from 2 to 10 horse-power each, and aggregating 44 horse power. The connections for such a system are shown in the accompanying diagram, Fig. 1. A view of the two-phase motor is presented in Fig 2. This machine is the joint invention of

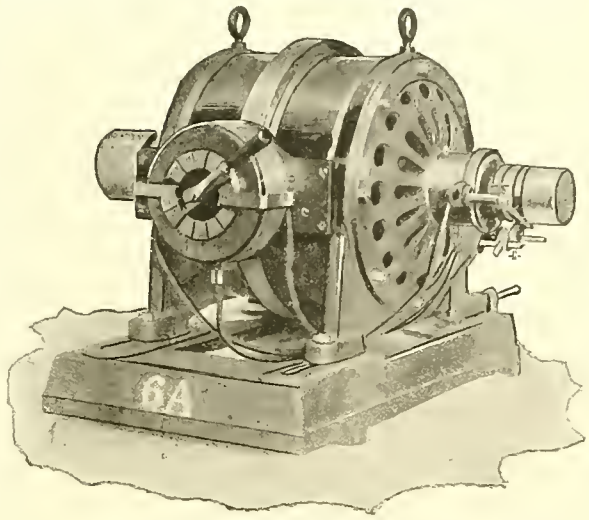

FIG 2. TWO-PHASE ALTERNATING CURRENT MOTOR ON LIGHTING CIRCUITS.

William Stanley, Jr. and John F. Kelly. The motor itself is of the type known as a transformer or two field motor. There are two fields and practically two armatures which act alternately as motor and transformer. The armature is short circuited on itself, the fields only being connected with the circuit. The current is supplied to the two fields by independent circuits in which there is a difference in phase of 90 degrees. It will be seen that this is a distinct type of motor from the so-called rotary field or Tesla type, there being no progressive shifting of the poles in the Stanley-Kelly motor.

The motor is well designed, very compact and without the accessory devices patented by Messrs. Stanley and Kelly, act about the same as other induction motors.

The great difficulty in induction motors heretofore has been the fact that they have taken about as much current on no load as on full load, and in order to overcome this difficulty, Messrs. Stanley and Kelly have resorted to the use of condensers in connection with the motor. Condensers are placed in multiple with each field of the motor in such a way as to furnish the lagging component of the current, with the result that the motor takes current from the generator about in proportion to its load, the same as direct current motors do.

Another element of trouble in the induction type of motors has been the self induction in the armature, and to overcome this the inventors have adopted compensating winding. This consists of short circuited coils placed in the field of the motor in such a way as to neutralize the effects due to the self induction in the armature. This combination gives them an efficient alternating current motor having good starting torque which takes current about in proportion to its load.

The accompanying diagram, Fig. 1, illustrates a two-phase generator from which runs a three wire circuit and shows how a general system of light and power can be operated without separate generators and circuits. Heretofore, it is claimed, a system of this kind would not be commercial on account of the heavy false currents developed by the motor. The generators, lines and motors would have to be exclusively large, and at the same time these heavy false currents would impair the regulation of the system so that satisfactory lighting service could not be accomplished.

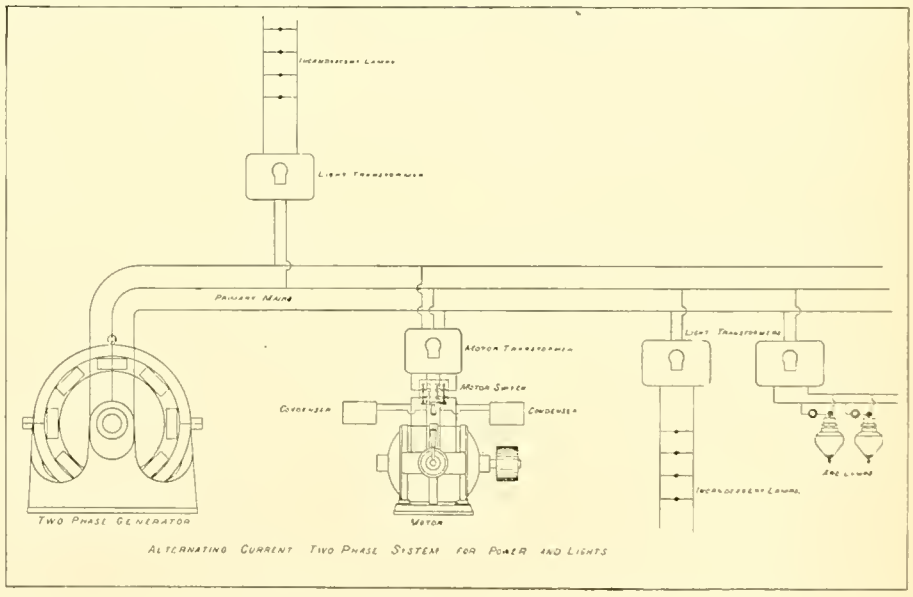

FIG. 1. TWO-PHASE ALTERNATING CURRENT MOTOR ON LIGHTING CIRCUITS.

Thiele Electric Lighting Bill.

When the Thiele electric lighting bill passed the Illinois Senate the WESTERN ELECTRICIAN requested C. H. Wilmerding, of the Chicago Arc Light & Power company, to present his views on the situation. Mr. Wilmerding was instrumental some years ago in forming an association of electric lighting companies in the state for the protection of their interests, and was elected president. He has given this subject considerable attention, and his views upon the Thiele bill, which are appended, will be read with interest:

"Senator Thiele's bill is one which all central station companies must necessarily look upon with disfavor. Aside from its being a measure aimed directly against their interests, it is a move in the direction of a paternal government, which is sure sooner or later to destroy commerce, as it takes away the only incentive which capital has to invest in progressive enterprises. The fact that this bill passed the Senate is to be regretted; whether it will pass the House or not remains to be seen. The chances are, however, that it will do so; and if it does, there is little doubt but that the governor will sign it. As far as its immediate effect on Chicago will go, the city is in no condition, financially, to go into the lighting business. I do not anticipate any competition from the city on this account for some years to come.

"In reference to the State association which you refer I may say that such an Association was formed some years ago, but that the small stations throughout the state seemed to take very little interest in the matter, and we have never been able to arouse enough enthusiasm to obtain a sufficient number of them enrolled. When any such question as this has come up, I have written them, whether they belong to the association or not, calling their attention to the necessity of concerted action, and I think that generally this has had some effect; but as an association we have not been able to accomplish anything in particular, owing to lack of strength."

Missouri Valley, Ia., is to have an electric light plant.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 22.—News of the decision in the lamp litigation at St. Louis aroused considerable interest in this city to-day, in fact it is the only topic of conversation among the electrical people. It was a good deal of a surprise, it is true, but it was a most pleasant surprise to a large number of dealers in incandescent lamps, the manufacture of which had been stopped by the Edison interests. Further developments will be awaited with considerable anxiety. It is not known just what policy the General Electric company will adopt, but it is hardly to be expected that it will discontinue its efforts to control the incandescent lighting business.

The bill which continues the life of the present Board of Electrical Control from November 1, 1893, unlike the bills of the last two years, contains the following clause: "The term of office of the present incumbents shall expire on November 1, 1893, and the mayor of the city of New York appoint their successors for the term of one year at a salary of $5,000 per annum, payable as the salaries of the present commissioners is paid. The successors of the present incumbents shall be subject to removal at the pleasure of the mayor." Under the present law the appointing power is in the governor. Should the new act receive Governor Flower's approval Mayor Gilroy can appoint three new commissioners, who may thoroughly reorganize the board's working force. This consists of an engineer at a salary of $4,800, an electrical expert at $2 500, an assistant secretary, clerk, stenographer and several inspectors at smaller salaries.

In a communication to the Brooklyn Board of Aldermen, Mayor Boody has asked that body to reconsider its action in granting franchises without compensation to the city to the Nassau Electric Railway company, the Kings County Electric Railway company, and the Brooklyn City Railway company. He said these companies were ready to pay large sums of money for the privileges which had been granted for nothing, and suggested that, if unprepared to act at once, the aldermen hold an extra meeting to make provision of a cash compensation that would be just to the city. In case the aldermen should make no provision for some payment for the franchise the mayor will veto the resolutions granting them. Representatives of the interested companies have already notified the mayor that they are ready to give the city a fair compensation for the franchises.

On Wednesday afternoon the last rail was laid of the Yonkers Electric railway connecting Yonkers and Mount Vernon—a distance of about three miles. This road will ultimately run to the Sound by way of New Rochelle.

At Sing Sing on Tuesday evening the Ossining Electric Railway company elected officers as follows: President, Abram S. Underhill; vice-president, John V. Cockroft; secretary, Frank L. Young; treasurer, Samuel E. Tompkins.

The work of laying the tracks for the new electric street railway in North Plainfield was begun last week on Somerset street, and is progressing rapidly. The superintendent hopes to have the line in operation by July 1st.

The Flushing and College Point railway has been tied up since 9 o'clock Thursday morning, when the conductors and motormen went on a strike. Dissatisfaction has existed among the men since the company gave notice some time ago that a new set of rules requiring the men to sign a contract and deposit $25 as a guarantee of good faith would soon be put in force. It is said that at first the men were about evenly divided on the subject, one-half being willing to sign the agreement and deposit the money, but the other half who objected succeeded in winning the rest over yesterday. All cars were run back into the car house and traffic on the road was suspended. The company operates about five miles of track connecting the villages of Flushing and College Point. W. F. O.

Milwaukee Wis.

MILWAUKEE, April 22.—The Edison Electric Light company has begun a suit in the United States Circuit Court for the Eastern District of Wisconsin, against the Electric Manufacturing company of Oconto, for the alleged infringement of the Edison incandescent light patent. The plaintiff asks for an injunction and for computation and payment of damages. It is claimed that 13,000,000 Edison lamps have been sold and that at the present time 1,000,000 are now in use in the United States. It is further alleged that the Oconto company has been manufacturing the Edison lamps at a large profit and at a correspondingly heavy loss to the plaintiff. T. A. Pamperin, Jacob B. Grunert and George Beyer, officers of the Oconto company, are made personal defendants in the case.

John M. Marvin, who is connected with the Davidson theater, has invented a machine for baking brick by electricity. The machine is a simple contrivance, consisting of a table covered with iron brick molds. The table is eight by fourteen feet and holds 1,000 molds. The holes are joined together like pigeon holes. Each mold is the size of a brick which has been pressed but not baked, and has a loose cover so fitted as to follow the brick as it shrinks. The pressed bricks are placed in the molds, the covers adjusted and the current turned on. The iron sides of the molds form the resistance and the bricks are virtually enclosed by walls of fire. When the bricks have shrunk to the right size, the covers automatically turn off the current and the bricks are dumped. By the ordinary process it takes three days to bake bricks, but Mr. Marvin claims that by his process they can be baked in three and a half hours. He also says that by his process the bricks are baked harder and better than by the usual process. In the ordinary method the presence of mineral in the clay causes the bricks to crack, but Mr. Marvin says that in the electrical process the more mineral there is in the clay the better, because it forms a resistance and heats the interior of the brick. Mr. Marvin states that he has sold the right to make brick under his patent for $25,000.

The Milwaukee Street Railway company has not yet taken possession of the West Side railway. The transfer, it had been expected, would occur on April 1st, but the Villard people decided to take advantage of the three months of grace provided in the contract. The third and last payment can be made any time before July 1st. Henry C. Payne, speaking of the matter, said that the delay in taking possession of the other line was due to the stringency of the money market and to the attempts which are being made to enact legislation hostile to street railway interests.

The Wisconsin Automatic Telephone company is making arrangements to establish an exchange at Sheboygan. A list of subscribers is being prepared and it is proposed to place the bulk of the stock among the home capitalists. It is estimated that the cost of putting in a telephone plant at Sheboygan will be in the neighborhood of $30,000.

The Wisconsin Telephone company has had a great deal of trouble recently as a result of the wind storms. In part, at least, the system has been out of order most of the month. The Chicago-Milwaukee wires have just been repaired. The total loss to the telephone interests of the state by the recent storms is estimated at $30,000, which will have to be borne by the general company.

A city ordinance requires street cars to stop within a certain distance of railway crossings. The street railway people have claimed that instead of ensuring the passengers from danger, as it is intended to do, the practice is really dangerous, on account of the likelihood of the trolley coming off and leaving the car powerless in front of an incoming or outgoing train. Their theory was aptly illustrated a few evenings ago at the Clinton street crossing of the St. Paul Railway. A Bay View car stopped at the crossing, the conductor ran ahead and gave the "all right" signal and the car started again. As it reached the railway track, the trolley came off, and a train bore down on the helpless car. It was wrecked, but the passengers escaped before the car was struck.

On City Engineer Benzenberg's desk is a piece of lead pipe which was taken from a residence near the Becker street railway power house and which seems to have been damaged by escaping electric currents. Since the introduction of the trolley system, there have been several cases of this character in the city. Gas pipes and water mains, it is stated, have been damaged by electric currents which escaped into the ground and attacked the pipes and mains by electrolysis. Mr. Benzenberg says that in time the current may do damage to the large water mains of the city. He has a letter from the head of the New Orleans water works suggesting that the matter be discussed at the convention of American engineers which will be held in Milwaukee next fall. Reports of damage to pipes underground by means of electrolysis have been received from Saginaw, Indianapolis, New York and other cities.

The extensive and tedious task of replacing every electric light wire by new ones in the Pabst block is now under way, as a result of unsatisfactory service from the wires put in at the time the building was erected. It was found that the wires used were insufficiently insulated and that dampness effected them in many parts of the building. It was finally decided to put in an entirely new supply of better insulated wire. When it is taken into consideration that something like 30,000 feet of wire is to be put in, and drawn through the conduits in the walls by means of the old wire, the work required will be better understood.

The work of completing the double tracking of the Wauwatosa electric road is now under way. The second track was more than two thirds down when winter weather stopped the work and the small balance will be down in two weeks. Ever since the road was put into operation it has been a paying line, and the stockholders propose to give the best possible service during the coming summer. C.

Northwestern Notations.

MINNEAPOLIS, April 22.—About the worst storm of this particularly stormy winter swept over the Northwest on April 20th. It found the street railway companies arranging for their summer business and poorly prepared for such a return of snow and cold. The service in Minneapolis and St. Paul was badly crippled, particularly in the former city. Stillwater, Duluth and other smaller places were obliged to exist without street cars for some time, and it was a difficult matter to resume traffic Friday.

A sanguine St. Paul paper predicts that within five years every wire in the city will be under ground. The good work is going on slowly but surely, and the wires of two electric light companies are now partly under ground. Most of the telephone wires are down. An ordinance has just been passed which gives the Western Union Telegraph company the desired right to bury wires. The ordiance is general, and not just what the company wanted, but it has been accepted. It provides that all companies operating or controlling electric wires shall place them underground within three years. The St. Paul Gas company purposes to put its electric wires down shortly.

Plans have been perfected for the new power plant of the Winona, Minn., General Electric company. It will be a one-story brick building, 120 by 140 feet. The electric light plant will consist of four 50 arc light dynamos, one 30 arc Thomson-Houston dynamo, and 30 light Edison dynamo, and one new Thomson-Houston incandescent dynamo. The car house will be 40 by 108 feet. Everything about the plant will be made as complete as possible.

The scheme of building an electric line to Lake Minnetonka, the popular summer resort, fifteen miles from Minneapolis, is considered almost every spring, and it has already appeared this season. There is probably no likelihood of its materializing this year, but it is undoubtedly only a matter of time.

The Columbia Electric company of St. Paul has made an assignment to James A. Owens. The company's plant is on Edgerton street, and it also owns a warehouse. Egbert G. Handy is president and F. M. Catlin secretary. Its business was not very extensive. The liabilities and assets are each said to be in the neighborhood of $20,000.

John Luddon has sued the St. Paul Street Railway company for $10,000 because he was run into and hurt while walking along the track.

President Lowry is figuring on getting the famous Gilmore band to play at Lake Harriet this summer as a special attraction.

D. S. Smith, superintendent of construction of the West Superior Iron & Steel Works, has been given a responsible position by the Minneapolis Street Railway company.

Charles F. Baker, for ten years chief engineer of the big Pillsbury flour mills in Minneapolis, has resigned to accept a position in charge of the steam plant of the West End Street Railway company of Boston.

The new electric light company at Grand Forks, N. D., has secured a site and will begin work at once on a solid brick power building, to be completed and equipped by September. There will be a dynamo of 350 horse power and a reserve dynamo of 150 horse power.

In a damage suit against the street railway company Judge Smith of the Minneapolis District Court told the jury that as the company is obliged to run its cars on tracks it is not supposed to exercise as much diligence or care as the driver of a wagon, especially in the middle of a block.

The Stillwater, Minn., street railway tangle continues in bad shape. The receiver appointed a year ago reports that he cannot make the road pay interest on the $60,000 bonded indebtedness.

There have been no important developments in the street railway situation in St. Paul. Petitions are pouring in from citizens protesting against the present condition of things.

Surveyors are at work on the proposed electric line between St. Paul and Stillwater. It will probably be built this year. The route will be around by way of Wildwood.

The St. Paul & White Bear Electric Railway company has commenced running half hour trains to White Bear. Excellent service is planned for this summer.

The city engineer of West Superior, Wis., has recom-

mended that the city furnish its own electric lights. He figures that 300 arc lamps and 25,000 incandescents will cost less than the present arrangement.

It is proposed to extend the Ashland, Wis., electric line to Washburn, Wis. There is a good roadbed, and the distance is but twelve miles. A company will probably be organized.

N. L. P.

New England Notes.

BOSTON, April 22.—The consolidation of the electric street car lines of the Merrimac valley has at last been effected. Yesterday the directors of the Haverhill & Groveland Street Railway company, the Merrimac Valley company, and the Lowell, Lawrence & Haverhill road met in Boston and voted to consolidate, the two former selling out to the last named. The companies retain their old names but will be under one management. The purchasing company has been granted the privilege of building a line over the route desired in Lawrence and work will be soon commenced. Connection will be made through North Andover with the Merrimac Valley road. The main company has purchased land in Haverhill on which it will erect an immense car shop, factory and repair shop.

The West End Street Railway company of Boston has come out victorious in its opposition to the people who applied to the Legislature for permission to build and operate a storage battery street railway in Cambridge. The legislative committee on street railways has reported a bill to give the storage battery promoters permission to withdraw.

The West End Street Railway company has withdrawn all the tunnel scheme plans for rapid transit it had before the Legislature. President Whitney in his letter making this withdrawal stated that he did not feel that they were sufficiently familiar with the Greathead system of tunneling to go on with such a project.

The governor of Maine has vetoed the bill granting a franchise for an electric road between Lewiston and North Corner, a distance of 22 miles, on the ground that there was not population enough to support such a road.

The new building of the International Trust company of Boston is to be equipped with a 500 light dynamo coupled direct. Mather apparatus will be used.

The Lynn & Boston Street Railway company, is to extend its lines to Beverly. There has been a three years' fight against the trolley system, but the opposition is at last overcome. A single fare is to be charged from North Beverly to Salem or Peabody instead of two as in the past. The company will spend about $100,000 in the town this year.

The Norfolk Suburban Street Railway company has been granted a franchise to build an electric road from Dedham Centre to Hyde Park. It will begin work the first of May.

The Lynn Gas & Electric company is to erect a new power station 150 feet square, costing $150,000. It will have a capacity of 2 500 horse power. J. C. E.

PERSONAL.

A. O. Eckert, southern agent for Day's Kerite, is in Chicago. He will take charge of the Kerite exhibit at the World's Fair.

F. J. Hovey, acting general assistant of the American Telephone & Telegraph company of New York, and V. D. Hayes, chief of the mechanical department of the American Bell Telephone company of Boston were in Chicago last week.

NEW INCORPORATIONS.

Beecher Single Railway company, Buffalo, N. Y.; capital stock, $400,000; to manufacture and sell all kinds of electric motive power, locomotives, etc

Madison Electric Light & Power company, London, O.; capital stock, $10,000; manufacturing and furnishing electric light and power; H. H. Prettyman, London, O.

United Light & Power company, Georgetown, Colo.; capital stock, $35,000; to supply the towns of Georgetown and Silver Plume, Colo., with electric and gas light, heat and power.

East Reading Electric Railway company, Reading, Pa.; capital stock, $100,000; constructing and operating an electric railway in Reading, Pa.; Daniel Ermentwart, Reading, Pa.

Concord Light & Power company, Concord, N. H.; capital stock, $200,000; generating, distributing and selling gas and electricity in the city of Concord and vicinity; Leach & Stevens, Concord, N. H.

Hewitt Voltaic Electric company, Jersey City, N. J.; capital stock, $150,000; to manufacture, buy, sell and deal in electric batteries, electrical compounds and supplies, etc.; J. Herbert Potts, Jersey City, N. J.

Duplex Electric Trolley Manufacturing company, Chicago, Ill.; capital stock, $100,000 to manufacture and sell electric trolleys and other electrical appliances. J. M. C. Tyner, 101 Rialto building, Chicago, Ill.

Springfield Consolidated Railway company, Springfield, Ill.; capital stock, $750,000; to buy, lease, construct, maintain and operate horse, dummy, and electric railways in Springfield, Ill.; Frank H. Jones, Springfield, Ill.

Miller Railway Incandescent Signal company, Chicago, Ill.; capital stock, $250,000; to buy, operate and sell letters patent relating to inventions for railway and electric signals; Banning, Banning & Payson, 532 Temple Court, Chicago, Ill.

American Engine company, New Bound Brook, N. J.; capital stock, $200,000 to manufacture steam, gas electric and other engines, pumps, condensers and boilers, and to sell or rent the same, etc.; American Engine company, Bound Brook, N. J.

General Electric & Improvement company, Jersey City, N. J.; capital stock, $500,000; manufacturing, constructing, selling, dealing in, operating and licensing the use of apparatus, etc.; L. A. Chandler, 31 Nassau street, New York, N. Y.

McKeesport & Braddock Passenger Railway company, McKeesport, Pa; capital stock, $50,000; constructing and operating an electric railway in Alleghany county from McKeesport to Braddock; J.P. Humber, 93 Diamond street, Pittsburg, Pa.

Put-in-Bay & Southwestern Electric Railroad company, Tiffin, O.; capital stock, $3 000,000; constructing and maintaining a railroad to be operated by electricity or other motive power, except steam, between Ottawa and Findlay, O; Foraker & Prior, Cincinnati, O.

ELECTRIC LIGHTING.

New Hampton, Ia., has decided to put in an electric light plant.

The electric light plant of Yankton, S. Dak., is to be considerably enlarged.

The Lewiston, Mont., Electric Light & Power company has been formed with a capital stock of $10,000; the company proposes to erect and operate an electric light plant in Lewiston.

A franchise has been granted to the Power City Illuminating company, with the privilege to string wires and erect poles for an electric lighting system for Niagara Falls, N. Y.

On April 6th the electric light plant of Mt. Pulaski, Ill., was wrecked by the breaking of a portion of the machinery. Chief Engineer Stookey and Fireman Edward Wood, were seriously injured.

Boyd Anderson, chief engineer of the Texas-Mexican Electric Light company's power station at San Antonio, Texas, has contracted with the Southern Pacific Railroad company for a trial of his storage battery for lighting the passenger trains on the road. A car is to be equipped with the storage batteries and a number of incandescent lamps at once and put on between San Antonio and Sanderson as an experiment. If it prove satisfactory all the trains on the road may be similarly equipped.

The Chester Light, Water & Ice company is now receiving bids on a central lighting station, to be constructed at once, at Chester, Ill. Proposals on the entire work, or any part of it will be received until May 15th by Wm. H. Bryan, mechanical and electrical engineer, room 56 Turner building, St. Louis, where plans, and specifications may be seen. The plant will consist of one 35 light arc machine, and two 500 light, 2,000 volt alternators, with engines, boilers, etc. Contracts have already been signed in Chester for about 1,100 lights.

ELECTRIC RAILWAYS.

The Mobile Light & Railway company, Mobile, Ala., has closed the contract for the electrical equipment of its lines.

The Consumers' Electric Light & Railway company, Tampa, Fla., is shortly to add ten additional miles to its tracks.

An electric road twenty-five miles in length, to run from Southbridge, Mass., to a point in Windham county, Conn., is being projected.

The Court Street and East End and the West Side Railways companies of Binghamton, N. Y, will shortly equip their lines with electricity.

J. K. Tillotson's electric railway known as the Put-in-Bay Southern, of Toledo, O., is to be extended to Lakeside. Work will be commenced upon the new road at once.

The Sioux City, Ia., Street Railway company has closed a contract to operate the elevated road in the city in connection with its other lines, and will assume control of the road as soon as it can be equipped with an electric system.

The Waterloo County Electric Railway company has been organized with a capital stock of $450,000 to build an electric railway from Galt, through Preston, Freeport and Berlin to Waterloo, Ont. The company also intends to utilize the water power of the Grand river.

Upon application of the St. Louis Trust company, trustee of the bondholders, Judge John A. Williams, of the United States Circuit Court, placed the City Electric & Capital Street Railway company of Little Rock, in the hands of a receiver on April 19th. Col. S. W. Fordyce, president of the St. Louis & Southwestern (Cotton Belt) railway, was appointed receiver and his bond fixed at $100,000.

The agreement between the municipality of Peterborough, Canada, and the Canadian General Electric company for the street railway franchise has been signed by both parties. The rails for the railway have been ordered from Europe, and the electrical appliances will be made in the company's own shops at Peterborough. Work will be begun as soon as the ground is ready, and several miles will be constructed this year.

Permission has been granted by the authorities of the three towns of Northbridge, Sutton and Crafton in the Blackstone Valley for the construction of an electric road to connect these towns with Worcester, Mass. There is little doubt that the line will ultimately be extended to Uxbridge to meet the proposed line from the south, thus making an electric connection between Providence and Worcester. The company obtaining the franchises mentioned is the Blackstone Valley Street Railway company.

A public demonstration of the Waddell-Entz storage battery system was given last Saturday on the Second avenue route in New York. It would appear that the test was deemed successful; the trial from One Hundred and Twenty-seventh to Ninety-sixth street having been made in eighteen minutes and without a mishap. A party consisting of the officials of several lines of electric railways in the city and a number of electrical men made the trip and expressed themselves as pleased with the system. In the Waddell-Entz car the storage batteries fill the space under the seats, seventy cells being in each side, while the motor is situated under the middle of the floor. With one change it is claimed by the promotors of the system the batteries will propel the car thirty miles, and then can be recharged without being removed. The directors of the Second avenue line are satisfied with the test.

TELEGRAPH.

The central telegraph exchange at Paris, France, is simply a bureau of transmission, and neither directly receives nor distributes dispatches. It transmits 36,250 telegrams daily and furnishes employment to 500 men and 400 women.

The report telegraphed from Halifax, recently that the Commercial Cable company's cable across the Atlantic was broken is denied officially. The story arose from the fact that the Mackay-Bennett steamer had been sent out to do some subsidiary work.

TELEPHONES.

The Missouri, Kansas & Texas Telephone company of Kansas City, Mo., will put in a telephone exchange at Guthrie, Ok., at once.

In April, 1882, the telephone system was introduced in Berlin, Germany, with fifty subscribers. By the end of the year the number had increased to 458, and at the first of this year 20,000 telephones were in operation at the German capital.

The computed total number of telephone exchange connections yearly throughout the United States has advanced from 312,605,000 in 1886 to 600,000,000 in 1892.

From Portland, Me., to Spokane, a distance of about 400 miles, an overhead telephone line is to be built, and to this line, two-thirds of which will be owned by the Inland Telegraph & Telephone company, the Pacific Telephone & Telegraph company will contribute.

The Missouri Pan-Electric Telephone company organized at St. Louis, April 19th, with Sam Kennard as president. The new company announces that it will take advantage of the expiration of the Bell patents and erect lines at once. The same company put in a large number of instruments in 1886, but was defeated by the Bell company in a lawsuit and its telephones confiscated.

Miss Mary K. Sands, who owns a farm in Darien, Conn. is showing persistence in repelling the invasion of her land by telegraph linemen. The Postal Telegraph company has been at work running a line through the town and, it is said, has omitted to obtain permission of some property owners. When the men appeared on Miss Sands's place last week she made an emphatic protest. They paid no attention to this, so she went up to the village and hired four men with instructions to fill up the holes dug by the telegraph men as fast as the latter threw the dirt out. There was a conflict between the two forces, and by night four poles were set. On the following morning, when the linemen came to work, they found the poles flat on the ground, having been sawed off at the surface during the night. All the second day the two gangs of men bothered each other, neither making any headway, but no open rupture took place. Miss Sands is determined that no poles or wires shall be erected or strung across her farm, and has employed counsel to get an injunction.

LEGAL DECISIONS.

The contest between the Lynn Gas & Electric company and twenty three insurance companies was recently decided in the Supreme Court at Boston. In October, 1890, fire was discovered in the company's building and was extinguished with trifling loss, but the great Corliss engine, 50 feet from where the fire originated and completely separated from it, was destroyed. The company claimed that the fire caused a general short circuiting of the system; that this strained and broke a pulley, and that a flying fragment from the broken pulley struck and disabled the governor of the engine, in consequence of which the engine destroyed itself and the building. The case was first tried in Salem and decided in favor of the Gas & Electric company. It was appealed to the Supreme Court, which has now affirmed the decision of the lower court and has awarded the electric company $12,000 damages.

MISCELLANEOUS.

The annual meeting of the Michigan State Electric and Surgical society will be held at Lansing, May 10th and 11th.

H A. Learned, Tokio, Japan, recently visited the Thomson-Houston factories in Lynn, Mass., in the interests of an electrical plant in Tokio.

TRADE NEWS.

George Cutter, Chicago, will move on May 1st to 851, 853 and 855 Rookery building. The new offices, together with an enlarged storeroom, will give Mr. Cutter additional facilities for taking care of his growing business.

The Chicago Electric Wire company of Wilmington, Del., is claiming a great many superior merits for its high grade insulated wires. It asserts that the insulation resistance of its wire is five times higher than formerly, that it can stand any amount of bending and twisting without deterioration.

The Interior Wiring & Fixture company, 14 Clinton place, New York, is making particular exertions to place its Klein push-button switch for electric light circuits on the market. The company claims for this switch that it is very simple in construction, safe to use, and is quick acting. The company is also making a specialty of its flush or wall switches and its handy pendant or flexible cord switch.

The Gray National Telautograph company, New York, has gathered comments on the new invention of Prof. Gray from the daily papers and scientific journals whose representatives witnessed the first public test of the instruments in Chicago and New York, and has presented extracts in pamphlet form. An idea of the general interest which Prof. Gray's invention has aroused will be gained from a perusal of this collection.

The contract for the new power house of the Newton & Boston street railway at Newtonville, Mass., has been awarded to Westinghouse, Church, Kerr & Co. The steam pressure will be 130 pounds, using Babcock & Wilcox boilers. The generator room will contain two Westinghouse compound condensing engines driving Thomson-Houston multipolar generators. The original installation is for 400 horse power, and the station is to be in operation July 1st.

S. F. B. Morse of Cushing & Morse, agents for Day's Kerite, has just returned from the Northwest with a large number of orders. Mr. Morse is exhibiting an unique sort of advertisement in the form of "spelling sparks." A manager of an electrical plant is illustrated as advising a discouraged station manager to tear up his old circuits and put in a good wire. Upon being asked what wire to use, a spark is touched to the end of a cigar in the hand of the manager, and a traveling spark burns "Kerite" in the paper.

The Electric Appliance company of Chicago has recently made a number of small improvements in its Acme lamp socket, which add largely to the merits of the socket. The new socket is being sold, however, at even a lower price than formerly, and the demand is very large. A novelty in the incandescent lamp line is being exhibited by the same company. It is the latest thing out in the Packard lamp line, being a small 6 candle power lamp with a bulb about 1 1-2 inches in diameter mounted to fit any regular socket and of any ordinary voltage up to 52 volts. It is known as "Our Baby."

The American Silk Manufacturing company, Philadelphia, Pa., is calling attention to its raw silk machine wiper. These wipers have been extensively endorsed by underwriters as doing away with the danger of spontaneous combustion so common with the use of cotton waste, and in addition to this advantage they present the merit of economy owing to greater durability. No boiling is required for these wipers as the company furnishes a box containing a special compound for renovating the old wipers. The success met with in introducing this specialty is the surest guarantee of its worth.

The Electric Selector & Signal company, New York, will make a complete exhibit in the Department of Electricity, at the World's Fair, of the principle of individual electrical selection in its several applications. There will be shown in operation, a number of railroad semaphores and train order signals, six telegraph stations, six arc lights, several groups of incandescent lamps, four electric motors and a telephone circuit with four or five stations. At one end of the space will be a stand representing a central light station at which will be located the transmitter for cutting in and out the electric lights and motors, and at the other end will be a similar stand representing a railroad train dispatcher's office from which the various signals and telegraph stations will be controlled.

No more complete or comprehensive catalogue of electrical supplies has been issued than the book recently published by the F. P. Little Electrical Construction & Supply company of Buffalo, N. Y. One of the features of the catalogue is the chapter on information for steam and electrical engineers, giving minute and particular directions for placing dynamos, their care and accessories. The F. P. Little company is making a particular speciality of the Kester improved arc lamp, the patent of which it has recently secured, which is claimed to be far superior to other arc lamps. The incandescent lamp department of this company is very extensive and complete, and the cut-outs, switches, fan motors, insulators, batteries and meters are illustrated and described in a most thorough and satisfactory manner.

The Ansonia Electric company, formerly the Electrical Supply company, Chicago, reports continued large sales for its [illegible] brand moisture proof wire. The company continues to receive flattering reports from the Helios arc lamp, which is used on incandescent circuits, for which it is the western agent. One of the specialties manufactured by this company is the W-W lightning arrester. The sales on this article are most satisfactory, and as it is built on the latest theoretical principles its ultimate success can not be doubted. An order has been placed with this company by the electrical engineering department for the World's Fair for three Wirt volt indicators to read to 3,250 volts. These instruments will be used for testing circuits during the World's Fair. Another order for Wirt indicators was received for the Chicago Athletic building, Columbus building, Lexington hotel, Chicago, and the Cicero, Ill., Electric Light & Heat company.

BUSINESS.

The J. H. & D. Lake company, Massillon, O., manufacturer of friction clutch pulleys, cut-off couplings and other mechanical specialties is presenting the trade with a transparent glass paper-weight that is attractive in appearance and is as excellent in its way as the high grade of work this company turns out.

Two hundred miles of road have been equipped within three months by the Ansonia Electric company, Chicago, with its improved overhead railway appliances. It also reports having secured some very large contracts within the last month, and is to be congratulated upon the success with which its new material has met.

The Electric Appliance company, Chicago, has taken the agency for the Diehl ceiling fans and has already secured a number of contracts for installations in Chicago stores and restaurants. The large equipment recently placed in the "peacock annex" of the Boston Oyster House is a standing advertisement for the Diehl fan.

The Ball Engine company, of Erie, Pa., reports that it is flooded with orders and that its already large capacity is insufficient to meet the demands made upon it. The company is particularly successful in its compound and tandem engines and reports twenty-three recent shipments of engines varying from twenty-five to three hundred and fifty horse power each.

The Ansonia Electric company, formerly the Electrical Supply company, Chicago, is now placing on the market what it considers the most important specialty ever added to its line; that is, the new Sunbeam incandescent lamp, which was described in detail in the last issue of the WESTERN ELECTRICIAN. A good many claims are made as to its superiority, and it is thought by the manufacturers to be clearly outside of all lamp patents.

Out of all the buildings under construction in New York city since January 1st, for which the architects' specifications name electrical equipment, two only are using other than the interior conduit system. The metal covered conduit is now generally specified by architects. It is estimated that in the remodeled residence of Cornelius Vanderbilt at Fifty-seventh street and Fifth avenue, 100,000 feet of brass covered interior conduit will be used by the Tucker Electrical Construction company, which has the work in hand.

The United Electric Improvement company of Philadelphia, Pa., formerly the Heisler Electric company, manufacturers of complete central station equipment, which has handled the Heisler long distance series apparatus so successfully, intends to increase its business facilities. A new factory will be erected with the addition of improved machines and tools for the manufacture of all types of lighting and power apparatus and no pains will be spared to make this factory one of the most perfectly equipped for the manufacture of electrical supplies in the country.

The works of the Westinghouse Machine company have been running for a year with a full night force. The shops are crowded with a large amount of heavy work in addition to the regular line of manufacture. There are now coming through ten 600 horse power compound engines, of which eight are for the Philadelphia Traction company, for direct coupling to multipolar generators, and two are to fill an order placed by E. D Leavitt for the Calumet and Hecla mines, to be used in driving electric pumps for mine drainage. The company has just completed the shipment of six 1000 horse power engines for the Westinghouse Electric and Manufacturing company, to be used in filling its contract for lighting the World's Fair. These engines are also coupled directly to 10,000-light dynamos. They stand eighteen feet high and make 200 revolutions per minute.

ELECTRICAL PATENTS.

Issued April 18, 1893.

495,472. Yarn-feeding Device for Knitting Machines. Emanuel Buxtorf, Paris, France.

495,513. Insulated Pipe Joint or Coupling. Thomas J. Pierce, Philadelphia, Pa.

495,538. Dynamo-electric Machine. Thomas L. Willson, Brooklyn, N. Y.

Two or more brushes are applied to each field of force, so that the bars passing through one field may be connected serially instead of being necessarily in multiple. If six brushes are applied to each field the electromotive force derivable therefrom is increased six times.

495,547. Combined Electric Motor and Driven Machine. Rodolphus Fuller, Detroit, Mich.

495,550. Process of Concentrating Zinc Bearing Sulphide Ores. Gustave M. Gouyard, Denver, Colo.

495,552. Insulator. Louis Hills, New York, N. Y.

495,561. Commutator for Dynamo-electric Machines or Motors. Buchanan S. Paterson, Gateshead, Eng.

495,562. Field Magnet. Frank A. Perret, Springfield, Mass.

The field magnet is constructed in two parts, connected by a wedge or V-shaped joint. The joint is made in the iron core of the field magnet, and is surrounded by a coil of wire.

495,564. Electrical Bell. Henry B. Porter, New York, N. Y.

495,582. Ground Generator of Electricity. Michael Emme, Oakland, Cal.

The electrodes consist of soft iron and carbonized coke. These are placed in holes made in the earth, in which is placed a mixture, which, in combination with the earth material, makes an active agent. The substance employed in connection with the earth depends upon the character of the earth. If the ground is a vegetable mold, commercial concentrated nitric acid is used to saturate the coil, and peroxide of of manganese or pyrolusite should then be mixed with the mass.

495,587. Ship's Log. Charles F. Holt, New London, Conn.

495,588. Indicator Mechanism for Type-setting Machines. John Hooker, Beccles, Eng.

495,600. Electrolytic Apparatus. Gustaf O. Rennerfelt, Stockholm, Sweden.

495,601. Electric Arc Lamp. Frederick T. Schmidt, Bradford, Eng.

The upper and lower carbons are supported upon brackets which are capable of excursions upon vertical rods. A cord connects the two brackets and passes over a pulley. By means of proper lamp mechanism the upper bracket is lowered and the lower bracket raised when the carbons are to be brougnt together for the establishment of a proper arc.

495,608. Magnetic Ore Separator. George G. Crosby, New York, N. Y.

A magnetized drum or wheel is employed, over which passes an endless apron. The substance to be treated is fed upon this apron. The magnetic particles are retained upon the apron as it passes under the magnetic drum until they pass out of the magnetic influence of said drum. The non-magnetic particles fall from the magnetic drum when at a vertical tangent to the drum.

495,615. Cross-over Switch for Electric Railways. Frank B. Rae, Detroit, Mich.

495,620. Incandescent Electric Lamp. Eugene W. Applegate, Chicago, Ill.

A strip or washer of platinum or kindred metal is interposed between the neck of the bulb and a plug of glass or other substance which supports the leading-in wires and filament.

495,626. Electric Welder for Wire Fence Machines. John D. Curtis, Worcester, Mass.

495,632. Life-saving Device or Fender. William E. Holmes, Boston, Mass.

495,637. Process of Extracting Zinc by Electrolysis. Johannes Pfleger, Frankfort-on-the-Main, Germany.

495,638. Secondary Battery. Leslie B. Rowley, Ashland, Wis.

495,643. Electric Arc Lamp. William A. Turbayne, Detroit, Mich.

A fine wire solenoid is included in a shunt of the main circuit and a cut-out magnet in the main circuit. A gravity ring clutch is allowed to fall and support the upper carbon when the cut-out magnet is energized to release a detent. When the carbons become abnormally separated the solenoid is energized and the gravity ring clutch released from the carbon rod until the proper arc is again established.

495,649. Electric Arc Lamp. Charles F. Adams, Morrison, Ill.

495,674. Rail Circuit-closing Contact. Friedrich von Hefner-Alteneck, Berlin, Germany.

A piston is placed intermedially between the rail and a vessel containing mercury. As the piston is depressed by pressure upon the rail the mercury is caused to rise within another vessel whereby electric circuit is closed by a wire or other electrode becoming immersed in the mercury.

495,692. Trolley Wire Finder. Charles G. Cleminshaw and William H. Bradt, Troy, N. Y.

495,695. Electric Railway Trolley. William Duncan, Allegheny, Pa.

495,714. Lightning Arrester. Elihu Thomson, Lynn, Mass.

495,738. Electric Rotary Drilling Machine. Robert M. Jones, Salt Lake City, Utah.

495,770. Time Indicator and Signal for Races. Alfred Bartlett, Auckland, New Zealand.

495,772. Electric Arc Lamp. Ernest E. Beauvalet and Leon C. Beauvalet, Paris, France.

Two solenoids are employed, one in circuit with the carbons and the other included in a shunt circuit. A lever arm connects the cores of the solenoid. The lower carbon holder is supported upon a cord or chain, one end of which is secured to the lever arm, while the other is passed about a drum. When current is first established the main circuit solenoid is energized, which causes a pawl to rotate the drum and unwind the cord sufficiently for the proper separation of the carbons for the establishment of the arc. When the carbons are abnormally separated the solenoid included in the shunt operates the pawl to re establish a proper distance between the carbons

495,782. Electric Shoe Sole. Rufus F. Carnes, Winfield, Ala.

495,835. Matrix Making Machine. Casper L. Redfield, Minneapolis, Minn.

495,853. Lightning Arrester. Elihu Thomson, Swampscott, Mass.

495,861. Electric Belt. George F. Webb, Cleveland, O.

495,913. Danger Signal for Railway Crossings. James S. Savage, jr., Detroit, Mich.

495,928. Safety Attachment for Cars. Robert Bustin and Thomas J. McMackin, Boston, Mass.

495,929. Electric Cigar Lighter. William Carter and Charles E. Willey, Louisville, Ky.

495,932. Electric Lighting System. Henry Edmunds, jr., London, Eng.

495,936. Apparatus for Preventing Obstructions to the Flow of Oil in Oil Wells. Fulton Gardner, Chicago, Ill.

495,940. Electric Trolley. Jeannot W. Kenevel, Chicago, Ill.

495,941. Electric Motor or Generator. William Koedding, St. Louis, Mo.

495,951. Incandescent Electric Lamp Holder. Leroy C. Whitney, Jr., Milwaukee, Wis.

EUGENE F. PHILLIPS, Prest. W. A. HATHAWAY, Treas. W. H. SAWYER, Sec'y.

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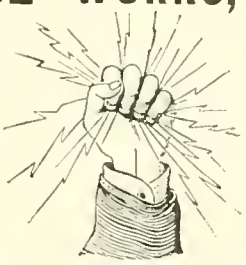

REMOVAL.

On or about April 15, 1893, we shall move our offices and general business address to 39 and 41 Cortlandt St. The factory will also be moved to our new property at Ampere (East Orange), N. J., D. L. & W. R. R.

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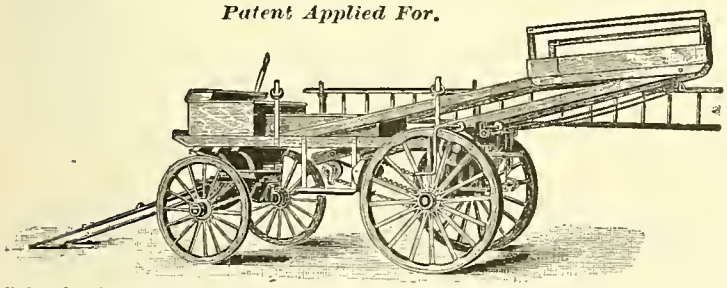

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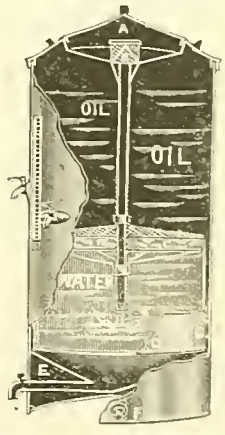

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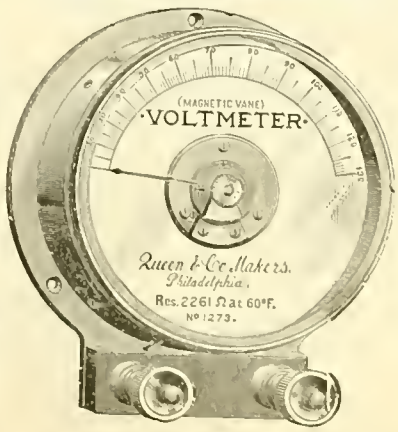

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Send five cents for Catalogue I-66 of Electrical Measuring Apparatus.

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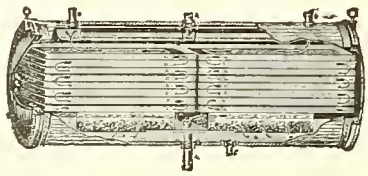

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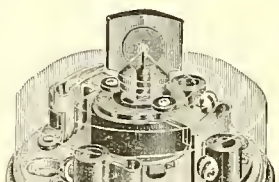

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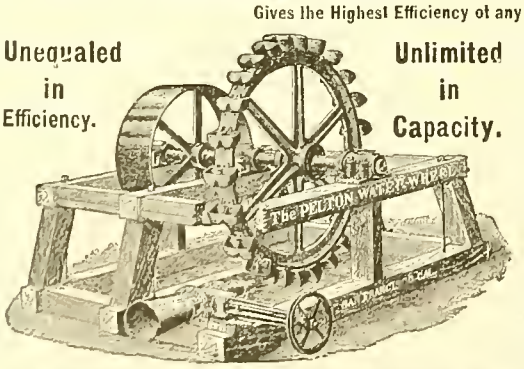

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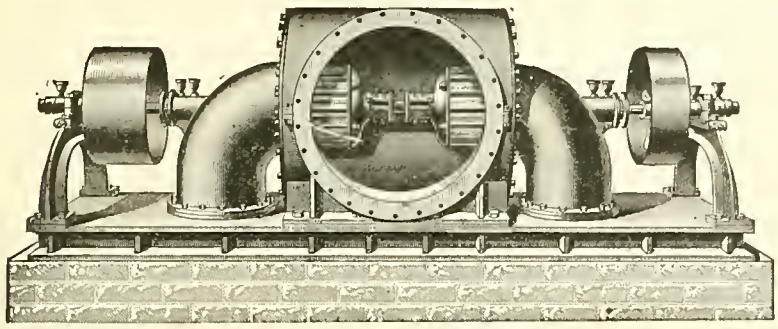

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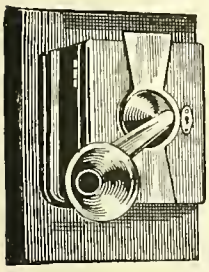

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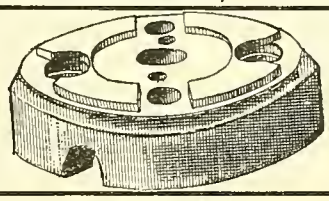

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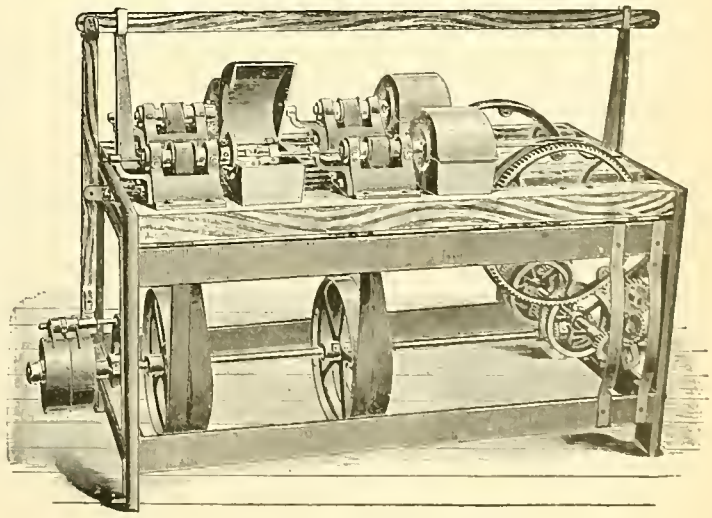

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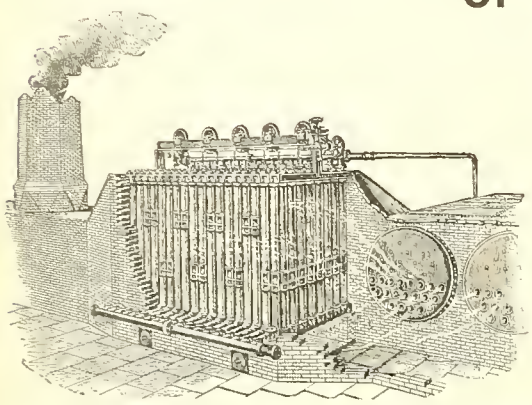

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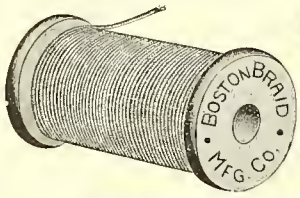

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Said railway property and franchises consist of about 6¼ miles of double track, being about 13 miles of single track, in said city of Milwaukee, with all the poles, wires, cables, trucks, ties, stringers, fixtures and appliances composing or used in connection with said tracks or said railway, with franchises, privileges and rights derived from ordinances of the common council of the city of Milwaukee to maintain and operate said road; also sundry parcels of real estate in said city, with car barns and power house thereon; also the engines, boilers, machinery and rolling stock and supplies of said road.

The terms of such sale are cash.

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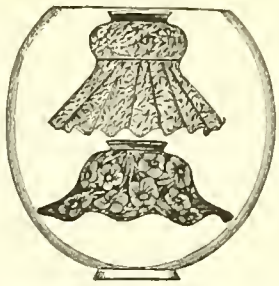

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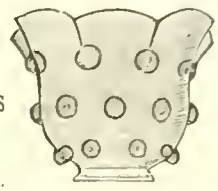

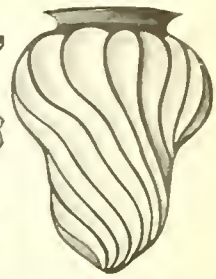

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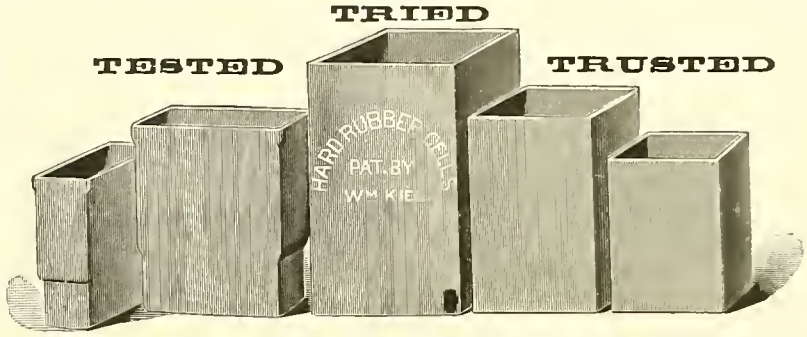

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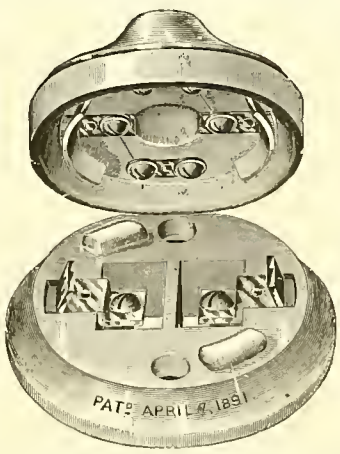

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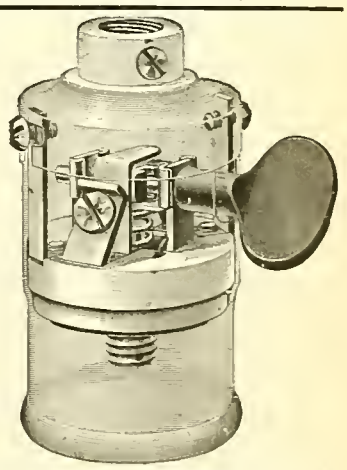

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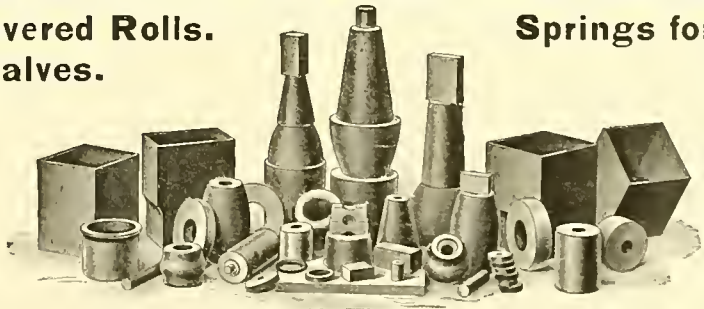

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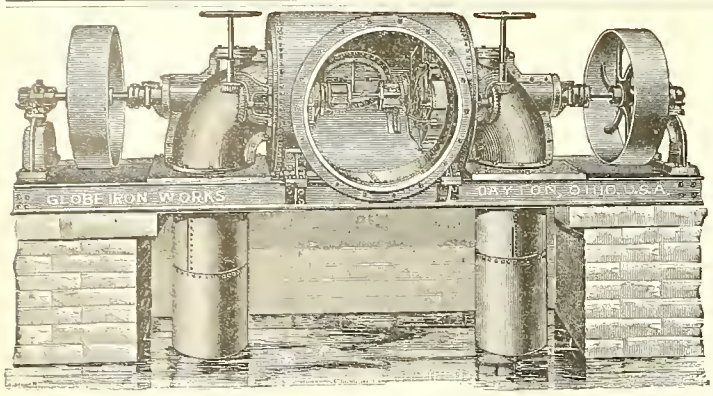

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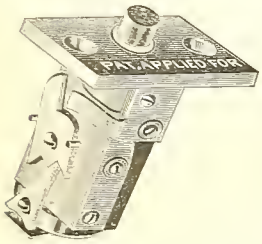

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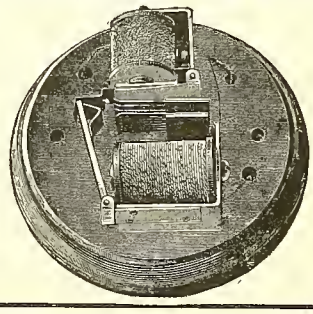

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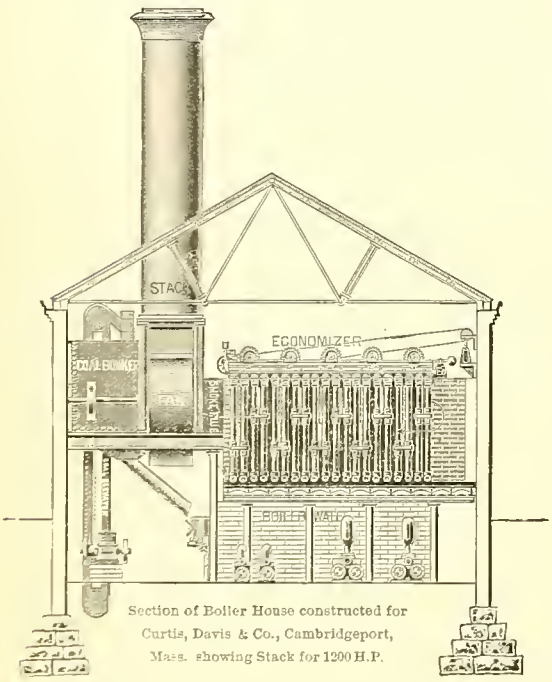

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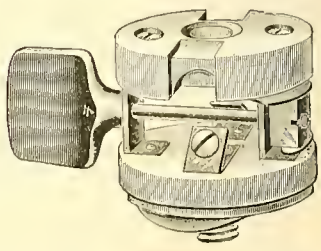

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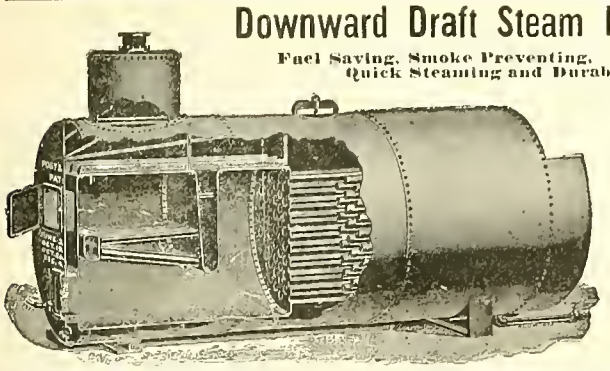

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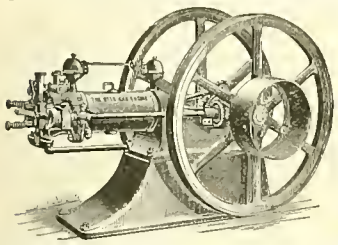

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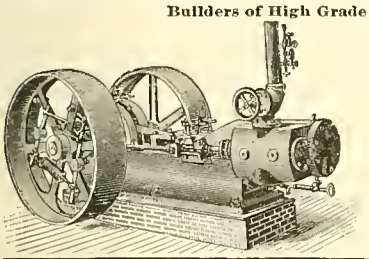

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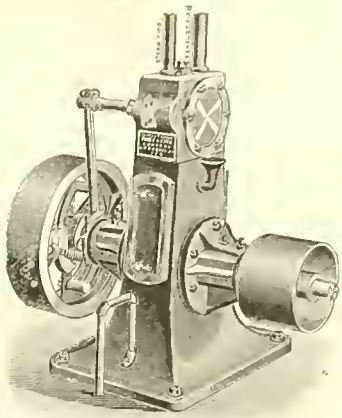

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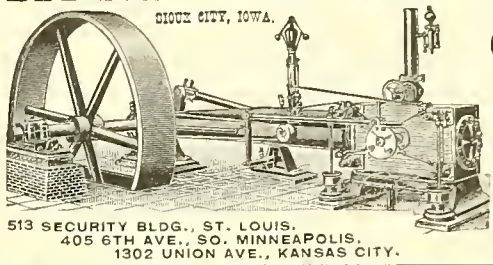

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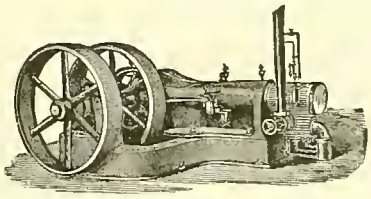

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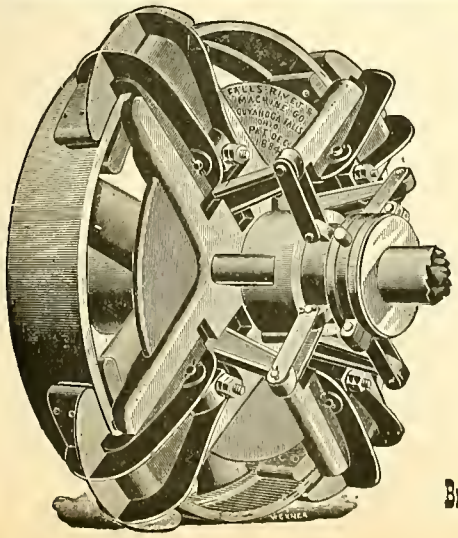

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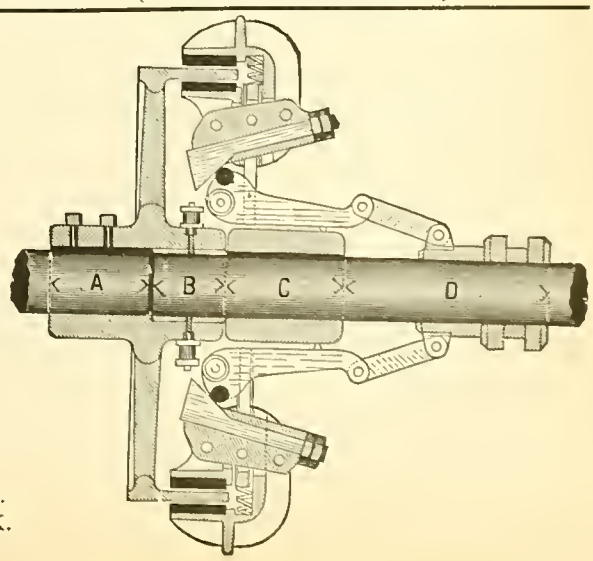

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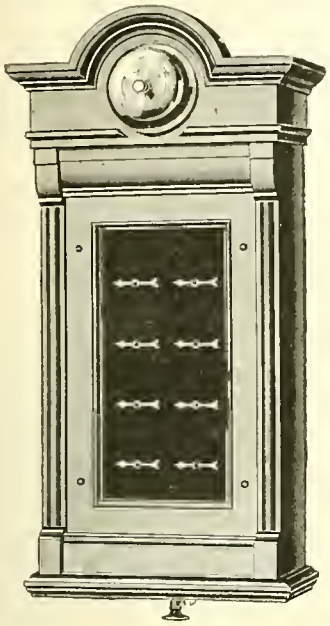

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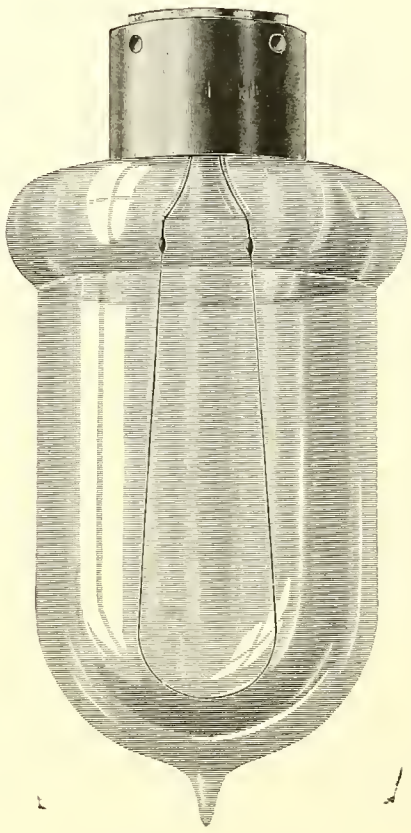

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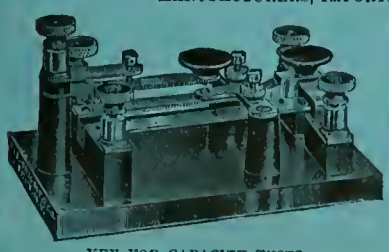

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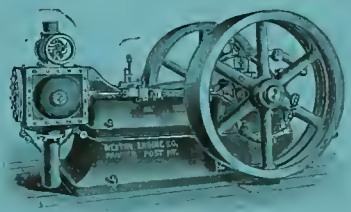

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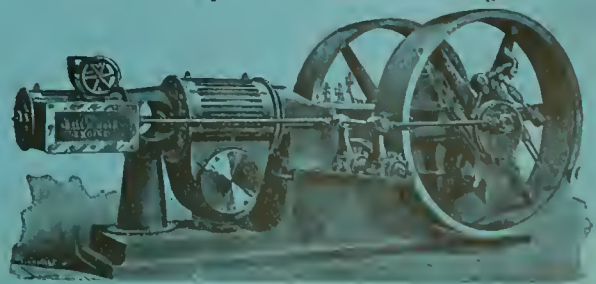

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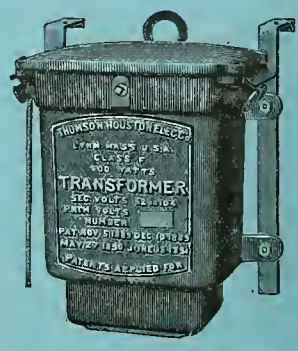

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Electrical and Mechanical Engineers.
Comstock, Louis K.
Mass. Elec. Engineering Co.
Osborne Steam Eng. Co.
Roberts, E. P. & Co.
Wilson & Jackson.

Electrical Instruments.
Ansonia Electric Co.
Central Electric Co.
Greeley & Co., The E. S.
Partrick & Carter Co.
Knapp Electrical Works.
Queen & Company, Incorp.
Weston Elec. Instrument Co.

Electrical Intelligence.
Comstock, Louis K.
Roberts, E. P. & Co.
Wilson & Jackson.

Electrical Specialties.
Columbia Mfg. & Supply Co.
Cutter, Geo.
Electrical Specialty Co.
Holtzer-Cabot Electric Co.
N. Y. Elec. & Develop. Co.
Paiste, H. T.

Electroliers and Combination Fixtures.
Ansonia Electric Co., The.
Baggot, E.
Edwards, W. S. Mfg. Co.
Knapp Electrical Works.

Electro-Plating Machines.
Brush Electric Co.
General Electric Co.

Engines, Gas.
Otto Gas Engine Works.

Engines, Steam.
Ball & Wood Co., The.
Case, J. T. Engine Co.
Freeman Sons Mfg. Co.
N. Y. Safety Steam Power Co.
McCay, H. K.
Phœnix Iron Works Co.
Racine Hardware Mfg. Co.
Sioux City Engine Works.
Taylor Engine Co.
Westinghouse Church, Kerr & Co.
Weston Engine Co.

Fan Outfits.
Ansonia Electric Co.
Calumet El. Mfg. & Eng. Co.
Clark & Marshall.
Diehl & Cmpany.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co

Fire Alarms.
Ansonia Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Fuel Economizers
Fuel Economizer Co.

Fuse Wire.
Ansonia Electric Co., The.
Knapp Electrical Works.
Shawmut Fuse Wire Co.
Sperry El. Mining Mach. Co.

Gas Lighting, Electric.
Ansonia Electric Co.
Boston Electric Co.
Electric Gas Lighting Co.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.

General Elec. Supplies
Ansonia Electric Co., The.
Bryant Electric Co.
Central Electric Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Electric Eng. & Supply Co.
Electrical Eng. & Supply Co.
Enterprise Electric Co.
General Electric Co.
Great Western Mfg. Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Law Battery Co.
Lee, C. E.
N. Y. Elec. & Develop. Co.
Paiste, H. T.
Palmer Bros.
Partrick & Carter Co.
Queen & Co., Incorp.
Redding Electric Co.
Russell & Officer.
Sawyer-Man Electric Co.
Simons, M. W. Electric Co,
Sioux City Elec. Supply Co.
Taylor, Goodhue & Ames.
Weston Elec. Instrument Co.

Globes and Electrical Glassware.
Brookfield, Wm.
Murray & Co., Jas. J.

Graphite Specialties.
Dixon Crucible Co., Jos.

Hard Rubber Goods
Butler Hard Rubber Co.
Delaware Hard Fibre Co.
Goodyear Hard Rubber & The India Rubber Comb Co.
Mica Insulator Co.
Newton Rubber Co.

Insulators and Insulating Materials
Ansonia Electric Co., The.
Brookfield, Wm.
Bryant Electric Co.
Butler Hard Rubber Co.
Chicago Insulated Wire Co.
Electric Eng. & Supply Co.
Empire China Works.
Enterprise Electric Co.
General Electric Co.
Goodyear Hard Rubber & The India Rubber Comb Co.
Hart & Hegeman Mfg. Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
International Okonite Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Knapp Electrical Works.
Mica Insulator Co.
Moore, Alfred F.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Standard Paint Co.
Vulcanized Fibre Co.

Insulated Wires and Cables—Magnet Wire.
American Electrical Works.
Ansonia Electric Co., The.
Bishop Gutta Percha Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent In. Wire & Cable Co.
Cushing & Morse.
Cutter, Geo.
Eastern Electric Cable Co.
Electric Appliance Co.
Enterprise Electric Co.
General Electric Co.
Goodyear Hard Rubber & The India Rubber Comb Co.
Great Western Mfg. Co.
Holmes, Booth & Haydens.
International Okonite Co.
Knapp Electrical Works.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Son's Co., J. A.
Shawmut Fuse Wire Co.
Sperry El. Mining Mach. Co.
Standard Underg. Cable Co.
Waddell-Entz Company.
Washburn & Moen Mfg. Co.
Western Electric Co.

Lamps, Incandescent
Ansonia Electric Co., The.
Bernstein Electric Co.
Central Electric Co.
Edison Miniature Lamp Dept.
Electrical Eng. & Supply Co.
General Electric Co.
Knapp Electrical Works.
Mather Electric Co.
New York and Ohio Co.
Sawyer-Man Electric Co.
Star Electric Lamp Co.
Steuben Lamp Works.
Waring Electric Co

Laches
Bridgeport Machine Tool Wks.
Shepard, H. L.

Lightning Arresters
Knapp Electrical Works.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Bridgeport Mach. Tool Wks.

Medical Batteries.
Law Battery Co.
Partrick & Carter Co.

Mica.
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

Mining Apparatus, Elec
General Electric Co.
Great Western Mfg. Co.
Sperry El. Mining Mach. Co.
Westinghouse El. & Mfg. Co.

Motors.
Brush Electric Co.
C. & C. Electric Motor Co.
Calumet El. Mfg. & Eng. Co.
Clark & Marshall.
Commercial Electric Co.
Crocker-Wheeler Electric Co
Eddy Electric Mfg. Co.
Ford-Washburn Storel. Co.
Fort Wayne Electric Co
General Electric Co.
Great Western Mfg. Co.
Interior Conduit & Ins. Co.
Mather Electric Co.
Porter-Leavitt El. Motor Co.
Rockford Electric Mfg. Co.
Sioux City E. S. Co.
Taylor, Goodhue & Ames.
Waddell-Entz Company.
Westinghouse El. & Mfg. Co.

Oils.
Clarendon Oil & Refg. Co.

Oil Filters.
Acme Filter Co.

Paints.
Standard Paint Co.

Patents.
Paine & Ladd.
Rosenbaum, Wm. A.

Phosphor Bronze
Phosphor Bronze Sm. Co., Ltd

Pins and Brackets
Ansonia Electric Co.
Central Electric Co.
Loud & Sons' Lumber Co.

Platinum.
Baker & Co.
Siebert, G.

Paints.
Loud & Sons' Lumber Co.

Porcelain.
Empire China Works.
Paiste, H. T.

Publishers, Electrical.
Electrician Publishing Co

Push Buttons
Ansonia Electric Co.
Central Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Union Hardware Co.

Railways, Electric.
(See Electric Railways).

Rheostats.
Carpenter En. Rheostat Co.

Sal Ammoniac.
Ansonia Electric Co.
Innis & Co.
Klipstein, A.
Law Battery Co.

Separators, Steam.
Hine Eliminator Co.

Silk Braid.
Boston Braid Mfg. Co.

Silk Machinery Wipers.
Am. Silk Mfg. Co.

Speaking Tubes.
Ansonia Electric Co.
Central Electric Co.
Knapp Electrical Works
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Speed Indicators
Queen & Co., Incorp.
Weston El. Instrument Co.

Steam Heating.
Webster & Co., Warren.

Steam Pumps.
Hubbard, Norman.
Worthington, Henry R.

Street Cars.
Brill, J. G. Co.

Tapes, Insulating.
American Electrical Works.
Ansonia Electric Co., The.
Central Electric Co.
Crescent In. Wire & Cable Co.
Cushing & Morse.
International Okonite Co.
Knapp Electrical Works.
New York Insulated Wire Co.
Standard Paint Co.
Standard Underg. Cable Co.

Telegraph Apparatus.
Ansonia Electric Co.
Central Electric Co.
Electric Selector & Signal Co.
Greely & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Telephone Mouthpieces
Marcus, W. N.

Test Instruments
Ansonia Electric Co.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Company, Incorp.
Weston Elec. Instrument Co.

Transformers.
Ansonia Electric Co.
National Electric Mfg. Co.
Stanley Electric Mfg. Co.
Taylor, Goodhue & Ames.

Trolley Cord
Samson Cordage Works.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Wheels.
Dayton Globe Iron Works Co
Leffel & Co., Jas
Pelton Water Wheel Co.
Stilwell & Bierce Mfg. Co.

Universities
Institute of Technology.
Waring Electric Co.

Vacuum Pumps.
Hubbard, Norman.

Varnishes.
Standard Paint Co.

Water Heaters.
Webster & Co., Warren.

Water Wheels
Leffel & Co., Jas.
Pelton Water Wheel Co.

Wire, Bare.
Ansonia Electric Co., The.
Bishop Gutta Percha Co.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent In. Wire & Cable Co.
Holmes, Booth & Haydens.
Knapp Electrical Works.
National India Rubber Co.
Phillips Insulated Wire Co
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MAKERS OF IRON, STEEL AND COPPER, and Manufacturers of IRON, STEEL AND COPPER WIRE for all Purposes.

Oldest and Largest Manufacturers of Electrical Wires in the World.

Bare and Insulated Copper Wire

FOR ELECTRICAL PURPOSES.

Galvanized Iron and Steel Telegraph Wire.

Magnet Wire. Annunciator Wire.

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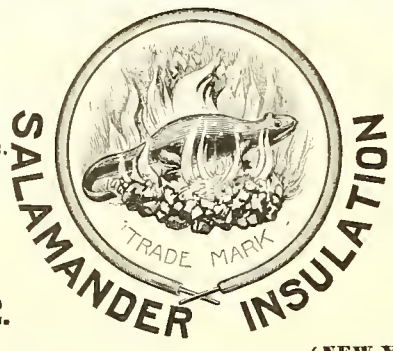
LEAD ENCASED WIRES.

HARD DRAWN COPPER TROLLEY WIRE.



Rubber, Weather-Proof and Underwriter's Wire.

ABSOLUTELY

FIRE and WATER-PROOF WIRE,

Superior to

Anything Heretofore Made.

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BRANCH OFFICES AND WAREHOUSES: { NEW YORK, 16 Cliff St. CHICAGO, 107 and 109 Lake St. SAN FRANCISCO, 8 and 10 Pine St. HOUSTON, TEXAS.

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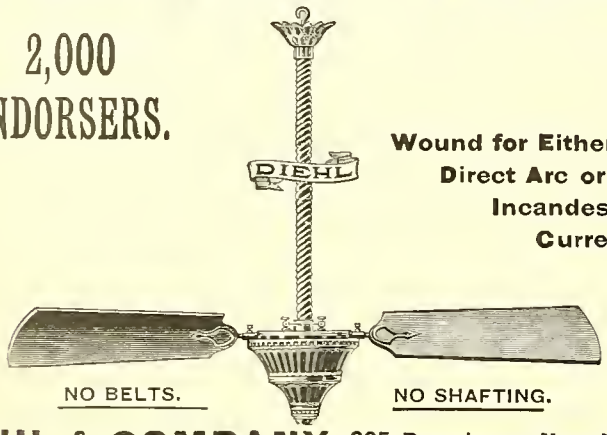

Wound for Either Direct Arc or Incandescent Current.

DIEHL & COMPANY, 385 Broadway, New York.

Chicago Insulated Wire Co.,

MANUFACTURERS OF

INSULATED WIRES OF ALL KINDS.

214 Northern Office Building,

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Weatherproof Wire.
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Magnet Wire.
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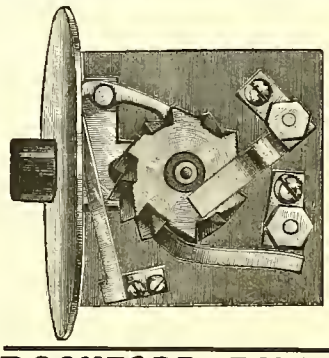
Bare Copper Wire.

The Electrical Specialty Co.,

1720 LARIMER ST., DENVER, COLO.,

Manufacturers and Owners of Woltman & Triggs'



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Single Push Button Flush

SWITCH.

Awarded the first prize gold medal at the Second Annual Industrial Exposition held at Denver, March, 1893. The only one-push button Switch in the market. If the light is out it turns it on, and if the light is on, push the same button and it turns it out. We make this Switch single pole, double pole, and 3-wire. This Switch is more practical and cheaper than any other push button Switch in the market. It does not need the aid of batteries, a shunt current or other cumbersome adjuncts.

PRICE, 10 Ampere, Single Pole, $1.50.

Liberal discounts to the trade.

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D. J. Hauss, Room 61 Pike Bldg., Cincinnati, Ohio.
A. Pizzini, Jr, 909 Bank St., Richmond Va.
Duerr & Rohn, 445 E. Water Street, Milwaukee, Wis.
Zenith Elec. Co., Lyceum Building, Duluth, Minn.
C. E. Dey, 1611 Champa St, Denver, Colo.
Smith Elec. Co, Butte, Montana.
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Brodney Morley & Co., Tacoma Wash.
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ROCKFORD ELECTRIC MFG. CO.,

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THE PIONEER LOW SPEED HIGH GRADE MACHINES.

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ALL SIZES, FOR ALL PURPOSES. THOUSANDS NOW IN USE.

PERRET-ELECTRIC-LIGHT-SYSTEM.

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Tamping Bars, Cant Hooks, Climbers,
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Sleet Proof Pulleys,
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OKONITE and CANDEE WIRES.
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Dynamos,
Motors and
Direct Current
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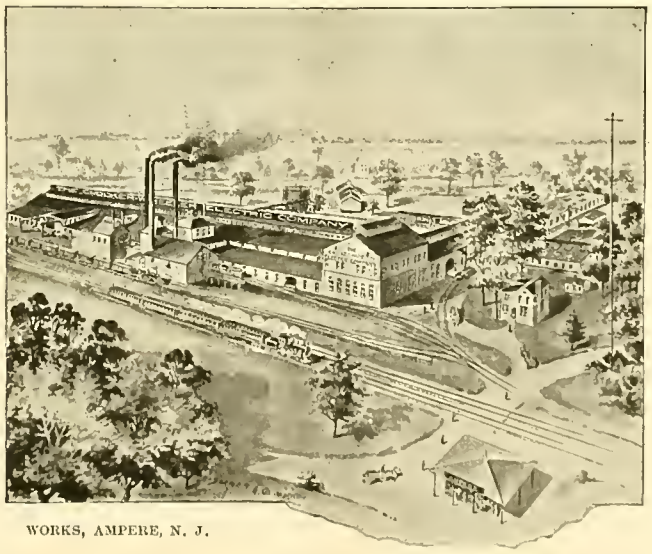
In all practical sizes and types.



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Special Application and Designs.

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Special Ventilating and Cooling Devices.

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DIRECT CURRENT VOLTMETERS AND AMMETERS

Are used in all parts of the civilized world. They are recognized by all authorities as the very best instruments ever produced.

During the past year Mr. Weston has given much time to the further study and improvement of these instruments, and has brought them to a higher degree of permanency, durability, accuracy and excellence than we ever thought possible. ***The New Model*** is the same in external appearance as the old, but is vastly superior to the latter in all that contributes to a first-class instrument. It is the ***acme*** of perfection, and is destined to become and remain

THE STANDARD PORTABLE INSTRUMENT OF THE WORLD.

We have perfected a larger model of these instruments expressly adapted for use as ***absolute standards*** in stations and laboratories. They are designated as the

Weston Laboratory Standard Voltmeters AND Ammeters.

The scales are about three times the length of the ordinary portable standards, and the instruments are sufficiently sensitive to work to within 1-75 of one per cent. We confidently recommend them as the most convenient and accurate standards known. They are adapted for the most exact work, and will be found thoroughly equal to its requirements.

We make twenty-two ranges of

The Weston Portable Alternating Current Voltmeters.

These instruments are absolutely permanent and very accurate, and are incomparably superior to any form of hot wire instrument known. They will be found invaluable in securing and maintaining uniformity and economy of operation of alternating current plants. ***We make multipliers for use with these instruments*** to extend their range so as to measure the highest voltage met with on primary circuits.

We also make sixteen different ranges of moderate priced, high grade

Dead-Beat Switch-Board Ammeters.

The capacity ranges from 25 amperes to 750 amperes. These instruments are a new type, and are very accurate and well made. The scales are very regular, the instruments very sensitive, thoroughly durable and absolutely permanent, and their indications are not sensibly affected by the most powerful external fields.

In addition we are making a full line of Direct Current

Station and Isolated Plant Voltmeters,

In three sizes and many ranges. These instruments are very dead-beat, and embody many new and valuable features. They are specially adapted for railway and power plants, and are well suited for arc and incandescent light circuits, and all other work requiring ***good and thoroughly trustworthy voltmeters.*** They are specially designed for switch-board use. We are also making a large line of high grade

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In ranges from 200 to 5,000 amperes, with absolutely proportional scales throughout the entire range. The sensibility and accuracy of these instruments have never been approached. A 1,200 ampere instrument will indicate, with full load or no load, the turning on or off of a single lamp, and can be read in any part of the scale to one ampere. They are very dead-beat, handsome in design and finish, permanent, durable, well made and moderate in price.

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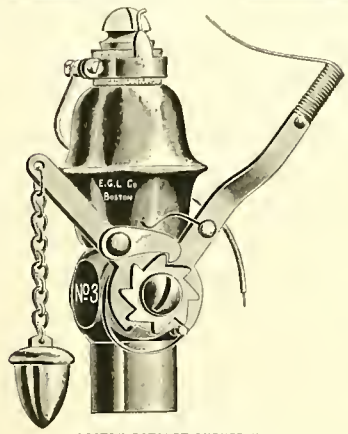
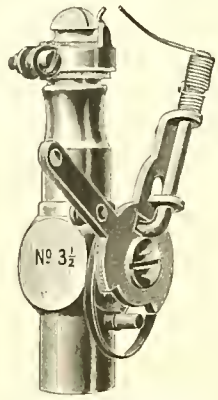
ELEVEN LEADING STYLES OF ELECTRIC GAS-BURNERS

Manufactured by THE ELECTRIC GAS LIGHTING CO., BOSTON, MASS.

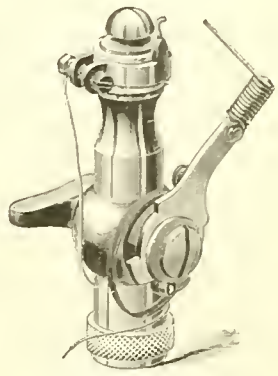


BOSTON RATCHET BURNER No. 3.
CUT FULL SIZE.

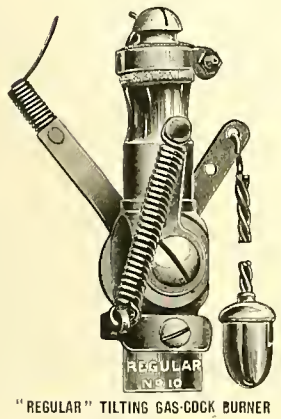
SINGLE WIRE "TRIUMPH" AUTOMATIC.
CUT FULL SIZE.
Pat. May 1, 1888, and Jan. 13, and 20, 1891.



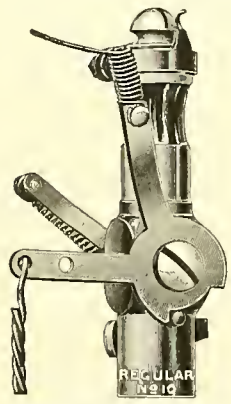
NEW BY-PASS RATCHET BURNER No. 3½.
CUT FULL SIZE.
Pat. March 2, 1880, and April 2, 1889.



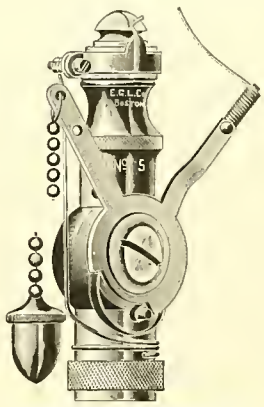
THUMB-COCK BURNER No. 13.
Pat. Aug., 1876, and April 7, 1885.



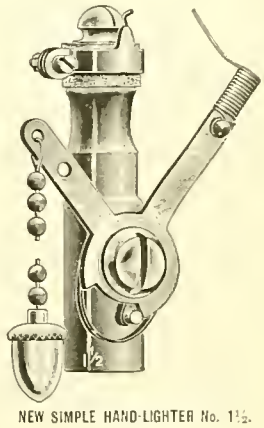
"REGULAR" TILTING GAS-COCK BURNER No. 10.
CUT FULL SIZE, REAR VIEW.



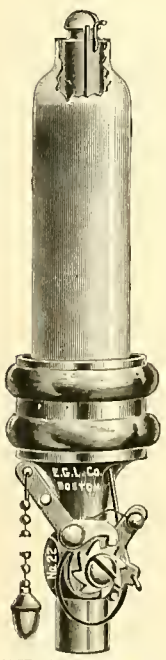
POSITION OF MOVABLE ARM AFTER GAS IS LIGHTED.



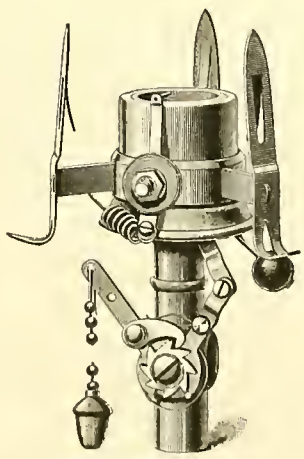
STANDARD SIMPLE HAND-LIGHTER No. 5.
Pat. Aug. 8, 1876, and April 7, 1885.



NEW SIMPLE HAND-LIGHTER No. 1½.
CUT FULL SIZE.



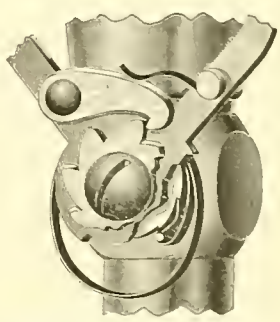
RATCHET CANDLE BURNER No. 22.
CUT ½ SIZE.



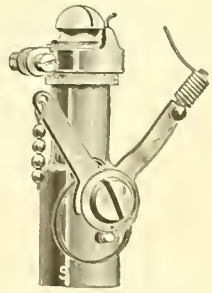
RATCHET ARGAND BURNER No. 18.
CUT ¾ SIZE.

No. 3 IN OPERATION.

METHOD OF OPERATING No. 13 BURNER.



RATCHET CHECK NOW USED ON ALL OUR RATCHET BURNERS.
CUT SHOWING RATCHET.



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CUT FULL SIZE.

Manufacturers, Importers and Wholesale Dealers

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ELASTICALLY SUPPORTED MOTORS. FLEXIBLE CONNECTIONS.

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All double carbon arc lamps at the Columbian Exposition are Brush, or under Brush license.

South Park, Chicago, has a model lighting plant. All Brush Apparatus.

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If you are interested in Electric Lighting or Power Apparatus, send for Catalogues or Call on

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Central Station Managers and others who contemplate placing contracts for Electric Apparatus, will do themselves a gross injustice if they do not at once

INVESTIGATE OUR

Arc Dynamo and Arc Lamps

For Municipal and Commercial Arc Lighting.

DIRECT INCANDESCENT APPARATUS

For Isolated and Commercial Lighting.

ALTERNATING INCANDESCENT APPARATUS

For Long Distance Lighting.

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WORKS: DULUTH, MINN.

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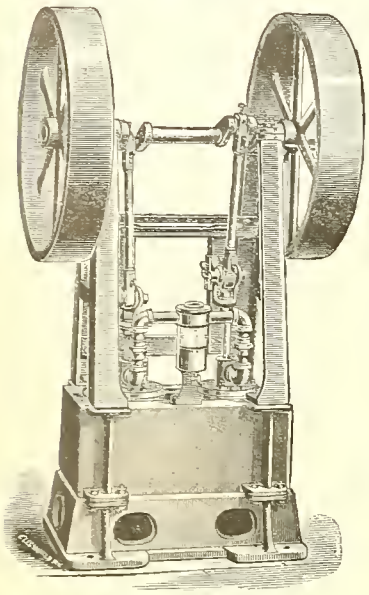

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PAGE BELTING CO. *Dear Sirs:*—In April, 1891, at your request, I made a careful test at your works of the driving capacity of various belts. Your Eureka Dynamo (slotted) Belt proved that the slotting not only still further diminished the slip, but that it materially increases the power attainable, in this respect surpassing one of the "perforated" belts (so-called) which was tested at the same time under the same conditions. The slotting is a decided advantage to the belt. This belt, under a very light strain, showed results which surpassed all others of which I have any record.

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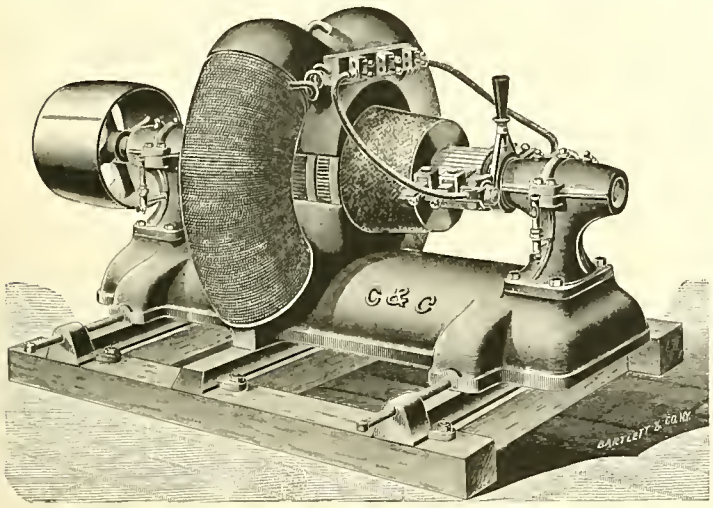

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ARE

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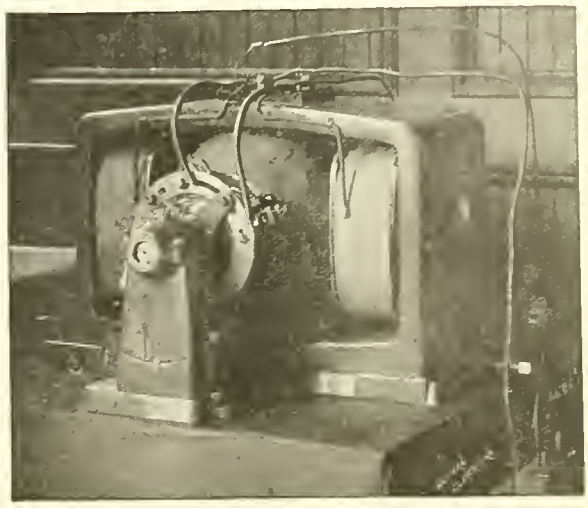

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Slow Speed.

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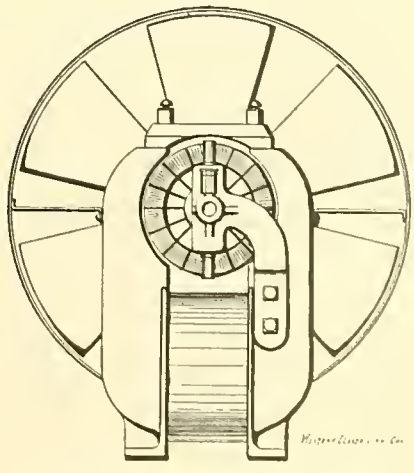

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"That's the Switch"

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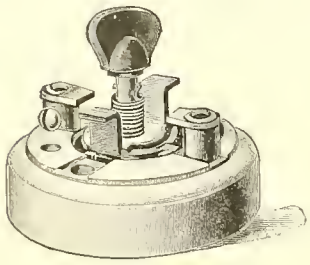
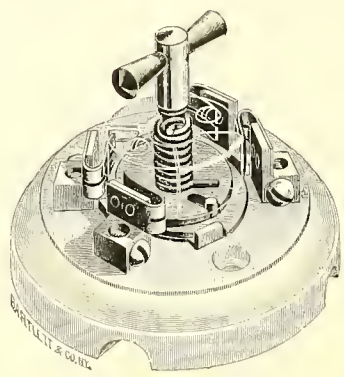


MADE

5	amp.	S. P.
10	amp.	S. P.
5	amp.	3 way.
10	amp.	3 way.



MADE

10	amp.	D. P.
15	amp.	D. P.

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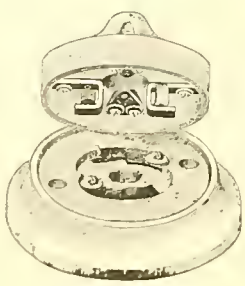

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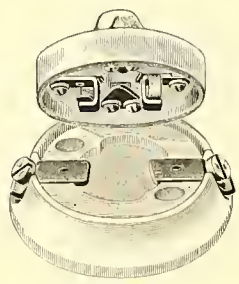

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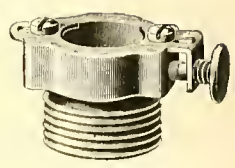
Adjustable Clutch for T-H. Arc Lamps.

All are invited to visit my booth in Electricity Building when visiting the WORLD'S FAIR.



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But it required no search to determine, in the minds of the Exposition Authorities, whose cable should be used for all the Incandescent Feeders and Mains underground at the World's Fair.

Universal Opinion, Based on Years of Conscientious Work, Settled the Question, and the

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THE MORRISON STORAGE BATTERY

Is made by the Planté process, no oxides being used, either mechanically or applied in the form of paste, paint or cement.

ELECTROMOTIVE FORCE HIGH; LIFE LONG.

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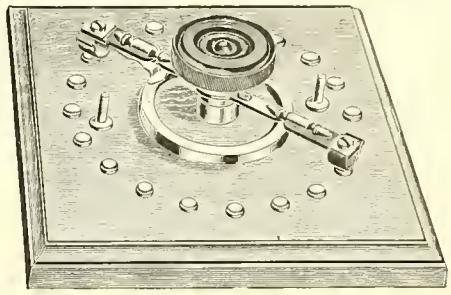
VOLTMETER SWITCH.

Are you a Station Manager? If so consider this.



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This switch enables the attendant to determine the voltage on any of the various circuits diverging from one or more dynamos.

Particularly Practical for Isolated Plants.

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Only Successful Alternating Current Arc Lamp.

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LOW TENSION ALTERNATING CURRENT ARC LAMPS.

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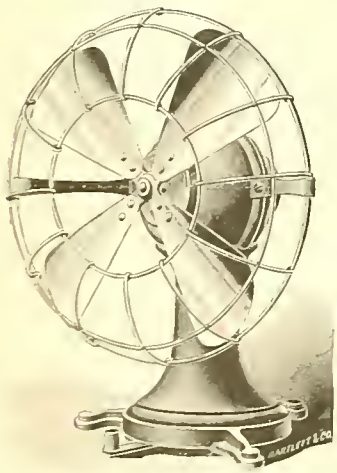
Graphite Rods of Various Lengths, from 1-5 Ohm to 100 Ohms Resistance to the inch. Graphite Boxes and Crucibles, Resisting Heats of 4,000 Degrees. Inquiries Gladly Answered.

JOS. DIXON CRUCIBLE CO., Jersey City, N. J.

1893 Model LUNDELL FAN MOTORS



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New Self Oiling and Self Aligning Bearings,

—AND—

Black Japanned Fans and Guards.

Order now and have a stock on hand ready to supply the demand the first warm day. The **house** with stock secures the **business.**

Interior Conduit & Insulation Co.,

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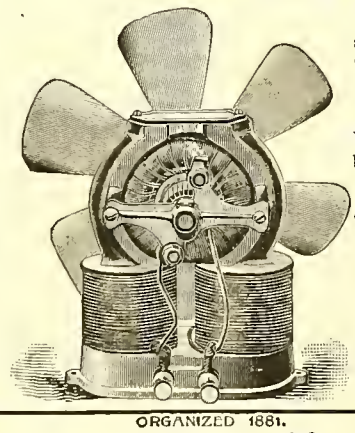
OUR IMPROVED '93 FAN MOTOR

IS THE BEST OUT.



It is ⅛ H. P., has fan 12 inches in diameter, self-oiling boxes, carbon brushes, tempered copper commutator; makes big breeze.

Our **DYNAMOS, MOTORS, STORAGE BATTERIES** and **STREET CAR MOTORS,** are praised by all. Write for catalogue.

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Search Light No. 13.

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PRICES.

8	C. P.	$0.30	20	C. P.	$0.35
10	"	.30	25	"	.35
16	"	.30			

DISCOUNTS.

Ten (10) per cent. to Central Stations.

Two and one half (2½) per cent. and upward to others, according to quantity.

ALLOWANCES.

Ten (10) cents for every burned-out lamp returned unbroken to factory.

EFFICIENCY.

By reason of an important discovery we now make our 50 volt lamps with an efficiency of 2½ watts per candle. This results in increasing the lighting capacity and earnings of a station

TWENTY PER CENT.

Shipments are now being made.

Detachable bases to fit any sockets five cents net, each.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

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SEND FOR A SAMPLE OF OUR

NEW SOCKET

Stating quantity wanted, and we will arrange to have our

PRICES SURPRISE YOU.

At the same time let us figure with you on general supplies.
Our prices are low and our goods are

"THE BEST AT ANY PRICE."

ALWAYS "IN IT."

ELECTRIC APPLIANCE COMPANY,

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SAMSON BRAIDED CORD.

Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

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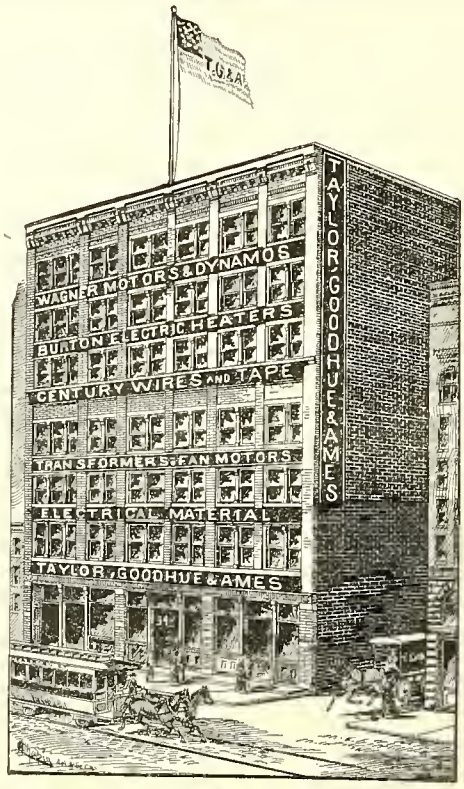

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Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. DENVER.

ANY CANDLE POWER. THE ANY VOLTAGE.

"STEUBEN" LAMP.

Write for Prices. STEUBEN LAMP WORKS, CANISTEO, N. Y. Samples Free.

NOTICE

January 27, 1893.

To the Electrical Trade:

I have this day assigned the entire interest in the Cleveland Switch, Patent No. 391,512, to THE BRYANT ELECTRIC COMPANY, of Bridgeport, Conn., together with the tools, patterns and moulds for making the Switches and Arc Cut-outs formerly manufactured and sold by THE FOREST CITY ELECTRIC WORKS, of Cleveland (Factory, Geneva, Ohio).

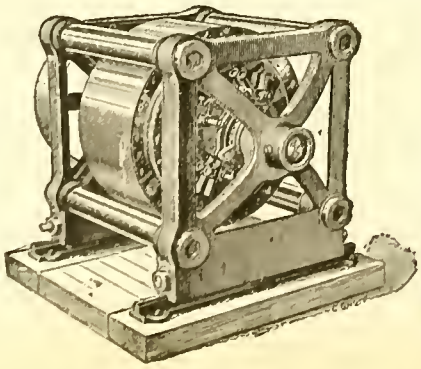
I trust that my former friends and patrons will extend to them the same good will and patronage that they have shown me in the past.

Very respectfully, (Signed) W. B. CLEVELAND.

THE BRYANT ELECTRIC CO. MAKES GOOD GOODS.

The WADDELL-ENTZ COMPANY,

203 BROADWAY, NEW YORK.



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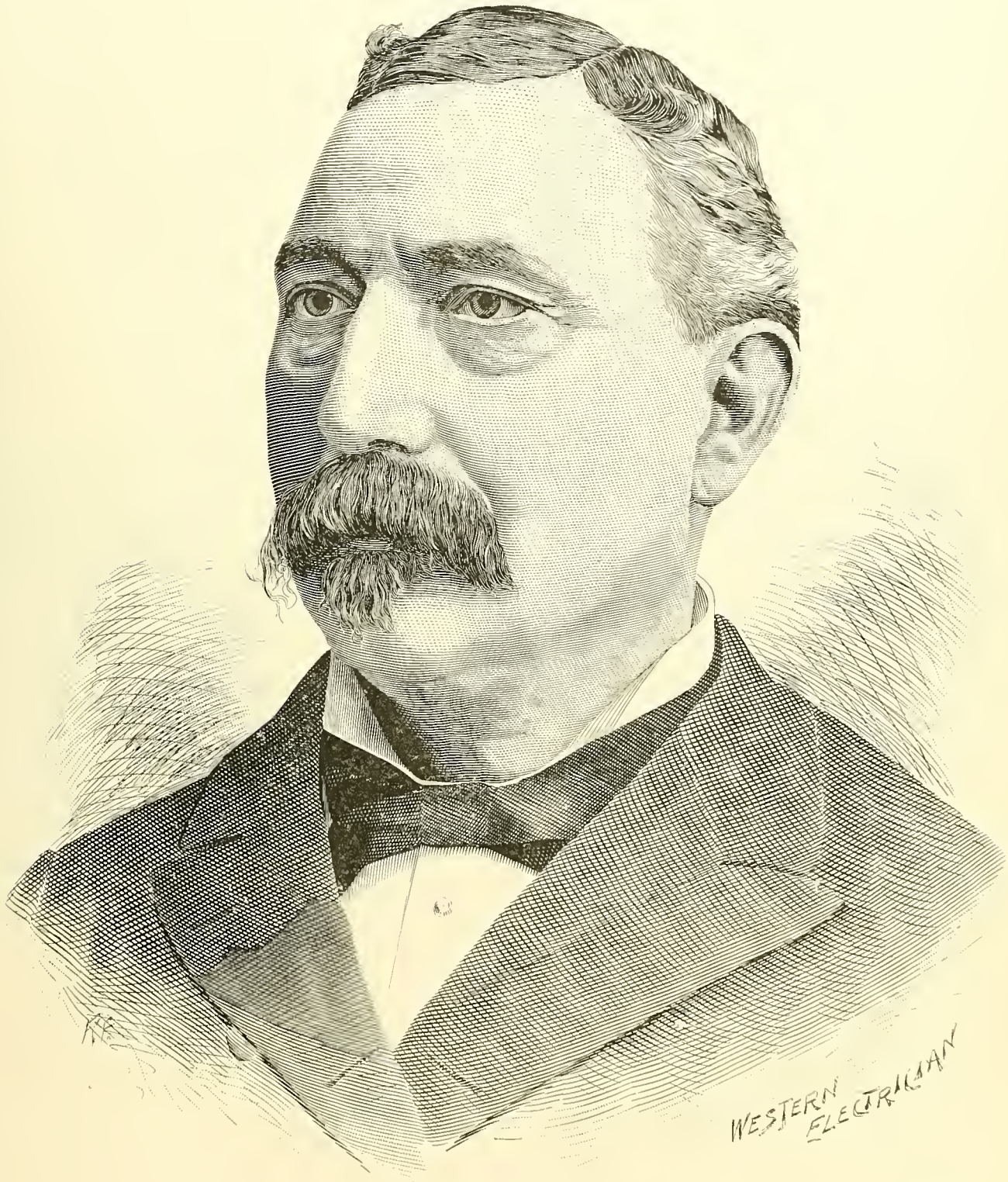
Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, MAY 6, 1893. No. 18



JOHN P. BARRETT,

CHIEF OF THE DEPARTMENT OF ELECTRICITY, WORLD'S COLUMBIAN EXPOSITION.

Department of Electricity, World's Columbian Exposition.

By J. Allan Hornsby.

The jurisdiction of the department of electricity extends over and covers nearly every exhibit and exhibition building on the grounds of the exposition, for manufacturers have taken advantage of a rule of the exposition which allows the listing for competition of all exhibits, whether the same be exhibited in the building provided for it or not, as is the case in many instances. Therefore the electric fountains, the intramural railway, the great search lights which will be scattered over the grounds, the entire arc and incandescent systems of lighting on the grounds and in the buildings, the various electric motors used for power everywhere, and last but not least, the electrical part of the great power plant, are all intended as exhibits of Professor Barrett's department.

The personnel of the department is as follows: Prof. J. P. Barrett, chief; J. Allan Hornsby, assistant chief; Willis Hawley, assistant; William Wilson Primm, engineer; J. W. Blaisdell, inspector of service; George R. Chambers, chief installation assistant, and Frank Sullivan, assistant.

The department was organized in February, 1891, and since that time has been actively engaged in the work of getting together an exhibit which will be thoroughly representative of the electrical industry not only in this country but of the entire world.

The power plant is fully described elsewhere in this issue, so that this article will merely cover the electrical building proper and the exhibits which may be found therein.

Electric power and a portion of the light is furnished from the power plant through the subway which leads from machinery hall to electricity building. The wires for this service are all now in place, and, though to an unpracticed eye there is seemingly much confusion and an apparent confosed mass of wires, in reality there is the most perfect order and system. Each individual or company has a certain well defined pathway allotted, and it is followed strictly.

Leaving the mouth of the subway under the southwest corner of the electricity building the wires lead directly by the nearest route, following the aisles, to the space of the exhibitor to whom they belong.

By amicable agreement between the department and the exhibitors all systems of both arc and incandescent lighting will be shown, affording the best possible chance for comparison, and as a result making the building the best lighted on the grounds.

There will be 436 arc lights to illuminate the ground floor and gallery, distributed as follows:

GROUND FLOOR.

German Government	27
Brush Electric company	15
Fort Wayne Electric company	7
Western Electric company	27
Excelsior Electric company	22
General Electric company	105
All night Service Lights	14

GALLERY.

Fort Wayne Electric company	69
Brush Electric company	62
Western Electric company	48
German Government	28
All Night Service Lights	12

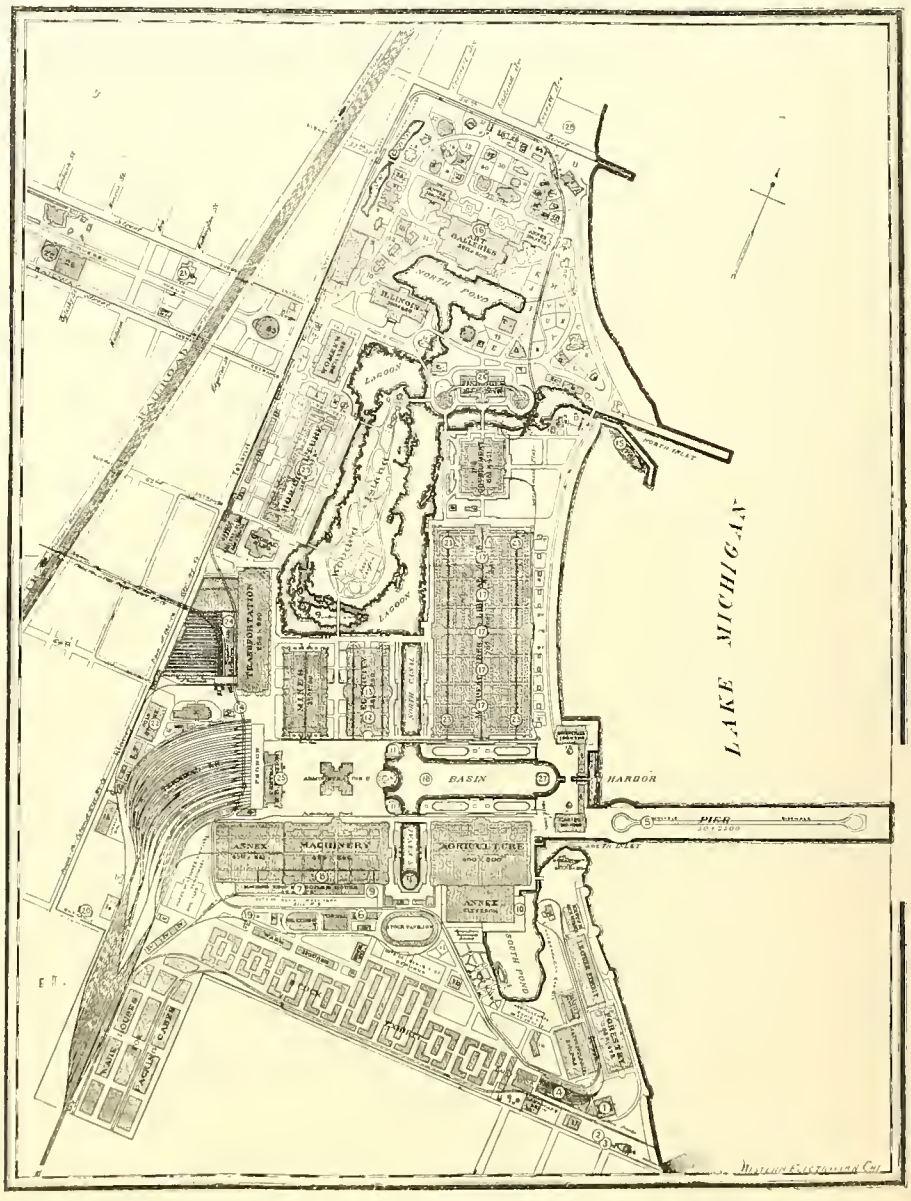
On the ground floor and in the galleries the lights follow the middle of the aisles and are placed twenty-five feet apart, and in addition there is a light on each truss. All lights are hung eighteen feet from the floors. Arc lights on handsome posts will be set around the edges of all the blocks in the great central nave. In the gallery a light is hung on each alternate truss and on each girder throughout the building in every aisle, giving a light every twenty-three feet and hung so that the arcs come 13 feet above the floor. The General Electric, Brush, Western Electric and Excelsior companies have their generators in Machinery Hall in the power plant, while the Fort Wayne company has established a central station in its space in the Electricity Building, where the generators are driven by motors. All these companies with the exception of the Excelsior furnish incandescent lights for their own use and for the use of other exhibitors, as well as power for the same purposes. In addition the Commercial Electric company and the Jenney Motor company contribute to this service.

The Westinghouse company will not be engaged in this particular service but will furnish some decorative effects which will be unique and startling.

A tour of the building shows that nearly all the exhibitors are present and are getting their displays in shape, while advices in the office show that the others have made ample preparations to be on hand in time. The diagrams presented herewith of the two floors of the building show that every foot of space has been assigned and shows the position of each exhibitor. In round numbers there was available 200,000 square feet of space available for exhibitors, of which France received 21,000; Germany, 23,000; Spain, 1,000; Austria, 1,000; England, 6,000; Italy, 1,000; Canada, 5 0, and the Principality of Monaco 1,000, American exhibitors taking the remainder.

Entering the building from the southeast entrance the display of the C. & C. Motor company is the first to attract the eye. The display will consist of all styles of motors, shown in operation, from the largest size to the smallest. Next comes the display of the Western Electric company; a beautiful temple of Egyptian design with decorative effects of concea'ed incandescent light is the principal feature. Inside, sunk into the walls, are show cases showing all kinds of electric appliances. These cases, lined as they are with dark crimson silk plush, give an exceedingly rich effect to the interior. The walls of this temple are decorated with the characteristic angular figures of Egyptian art except that the people shown thereon are engaged in extremely modern electrical pursuits. Back of this is shown a magnificent switch board of Tennessee marble with gold plated trimmings. Adjoining is a column of light made up of colored incandescent lights, while above all will extend a gigantic streak of lightning, forty feet long, made up of innumerable small incandescent lights which will be made to flash at intervals by a special mechanism. A model theater with novel effects in lighting will also be shown. A special feature of the exhibit will be the making of telephones. Two of the blocks of the Westinghouse company come next, in which there will be a characteristic display of the new stopper lamp and appliances. To the right will be found the Eddy Electric Manufacturing company with a full line of motors run from the Eddy generators in the power plant. Across the nave is the German government's ground floor display. It will unquestionably be one of the finest exhibitions ever shown. The decorations of the whole are superb. From the central nave it will appear as a palace of modern architecture, the whole being wrought out in staff and decorated with bunting, flags and electric lights. In this section the best displays of machinery will be made by Siemens & Halske, the Allgemeine Elektricitaets Gesellschaft and Schuckert & Co. of Nuremberg. Siemens & Halske have in Machinery Hall a combined engine and dynamo of the polyphase type of 1 200 horse power, which will furnish current for the German section. It will be remembered that it was the Allgemeine Elektricitaets Gesellschaft which created a furore at the Frankfort Exposition by bringing power from the falls at Lauffen to the exposition, a distance of one hundred and twenty-five miles. Schuckert & Co. will make a magnificent display of search lights.

The Electric Forging company, of Boston, will make a fine display of their method of drop-forging electrically heated metal, and will show some surprising results. Adjoining these are the dynamo belt displays of Charles A.



MAP SHOWING ELECTRICAL FEATURES AT JACKSON PARK.

1. Elevated Electric Railway Power Station.
2. Fuel Oil Storage Plant.
3. Oil Pump House.
4. Elevated Railway Car Barns.
5. Movable Sidewalk (electrically operated).
6. Electrical and Mechanical Engineering Department.
7. Boiler House.
8. Electric Lighting and Power Plant for General Service.
9. Pumping Station.
10. Charging Station for Secondary Batteries on Electric Launches.
11. Electric Fountains.
12. Electricity Building.
13. Edison "Tower of Light."
14. Power Connections on Elevated Structure.
15. Exhibit of Marine Lighting.
16. Art Gallery Incandescent Lighting, with Reflectors.
17. Coronas for Lighting Manufactures Building, Supporting 414 Arc Lamps.
18. Decorative Incandescent Lighting about Basin.
19. Westinghouse Office Building.
20. N. Y. Insulated Wire Co.
21. Libby Glass Works Isolated Plant.
22. Cold Storage Warehouse—Isolated Plant.
23. Schuckert Search-Lights.
24. Electric Transfer Table.
25. Siemens & Halske Five-wire Incandescent Installation.
26. Tank Lighting.
27. French's Statue of the Republic (Halo of Incandescent Lights).
28. Spectatorium (Curtain of Electric Light).
29. Artificial Cave in Horticultural Building for Testing Influence of Electric Light on Plants.

Schieren & Co., Munson Belting company and Page Belting company. The Schieren display is a booth made entirely of link leather belting arranged in an artistic manner to form a structure. The Belknap Motor company shows every conceivable application of the motor, from the homely coffee mill to motors of a size suitable for factory work of all kinds. Against the east wall comes the General Incandescent Arc Light company with a display of arc lights for home use to run on incandescent circuits, and next to it E. S. Greely & Co. with a display shown in a gold and white structure. In the northeast bay will be found the Curtis Electric Manufacturing company, the Jewell Belting company, the Chicago Belting company, the Commercial Electric company, the Union Electric company, and the Zucker & Leavitt Chemical company. The central block of this bay will be occupied by the Railway Equipment company of Chicago, which will show, among other novelties, an electric oven in which pies, biscuits, bread and cakes will be baked in plain view of visitors. It is worthy of note that this company filed the first application for space in the exposition, its installation number being one and its department number one. Going west, Queen & Co.'s display of fine testing instruments is next seen, arranged in handsome cases and giving a pretty effect in brass and dark wood.

In the French section, which comes next, will be found many objects of interest. The Societe Gramme will show dynamos of all types, among others the first dynamo with the ring type of armature built by M. Gramme, arc lights for lighthouse use, including one of 200,000 candle power. In general the display in the French section will be of a very artistic nature and will be more or less of a lighter character than that shown in the German division. Fine testing instruments and exhibits of a like character will be more liberally shown than electrical apparatus of a heavier kind. The government display of telegraph apparatus and meteorological instruments with electrical recording apparatus will be arranged as a weather bureau station, the recording apparatus being in the display while the observation apparatus will be installed in one of the towers of the building.

The exhibit made by Great Britain is somewhat of a disappointment, atoned somewhat by the display made by the postoffice department, which controls the telegraph. This exhibit will be of great interest, owing to its historical value.

In this section of the building will be found the exhibits of Canada and Russia.

L. G. Wing & Co., the Electrical Conduit company of New York, and the Elektron company are in this neighborhood. The Conduit company will show a magnificent set of cast iron conduits and manholes, and it is of interest to know that it was the first exhibit to be completely installed and set up, it having been ready for more than six weeks.

The Elektron company will have a passenger elevator in operation which will take visitors free of charge to the second floor.

The Standard Electric company of Chicago will make a fine exhibit of their arc lighting dynamo, the special feature of which is the ventilated armature. This will be an exhibit to be avoided by people with weak eyes, as sixty arc lights will be grouped together in attractive shape and will all be in operation at one time.

The Thomson Welding company will make an interesting display of welding machines, with specimens of their work, and show the machines in actual operation.

Dr. Hirsch will show the production of aluminum by electrolytic action; also its use with alloys as a substitute for steel.

The Mather Electric company has begun installation and will have a fine exhibit of power generators.

The Fort Wayne Electric company shows a complete central station operated by motor power. Two motors of eighty and 40 horse power each operate a line of shafting, which in turn drives two light arc dynamos and two incandescent dynamos, one of which is the new type of alternator of 1,500 lights capacity and of a size so small that it will excite the admiration of engineers and mechanics. The switch board designed by E. A. Barnes, who has the exhibit in charge, will be a handsome feature of this exhibit.

The Brush company will show a pavilion with a circular interior dome beautifully lighted with incandescent lamps.

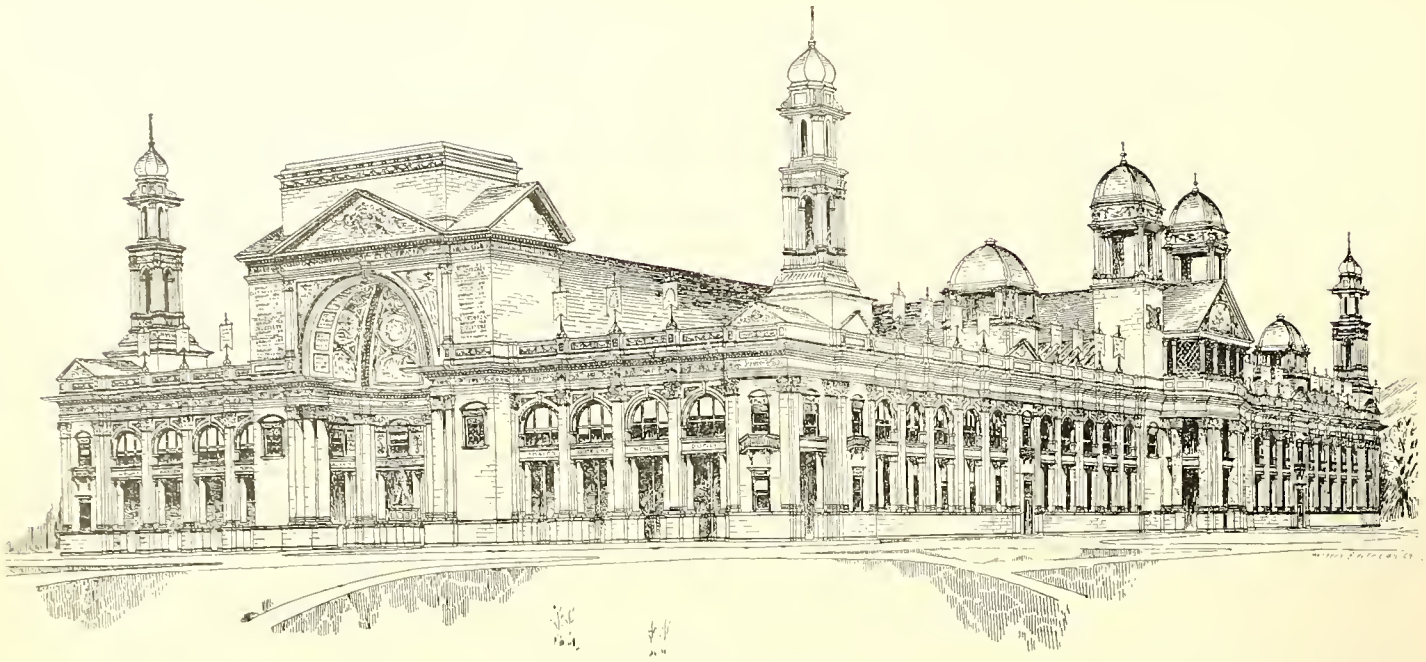
Hanson & Van Winkle will show a line of dynamos for electro-plating, also some historical apparatus loaned by the city of Birmingham, England.

The Jenney Electric Motor company will have a central station operated by direct coupled generators and motors by which they will light their section of the building.

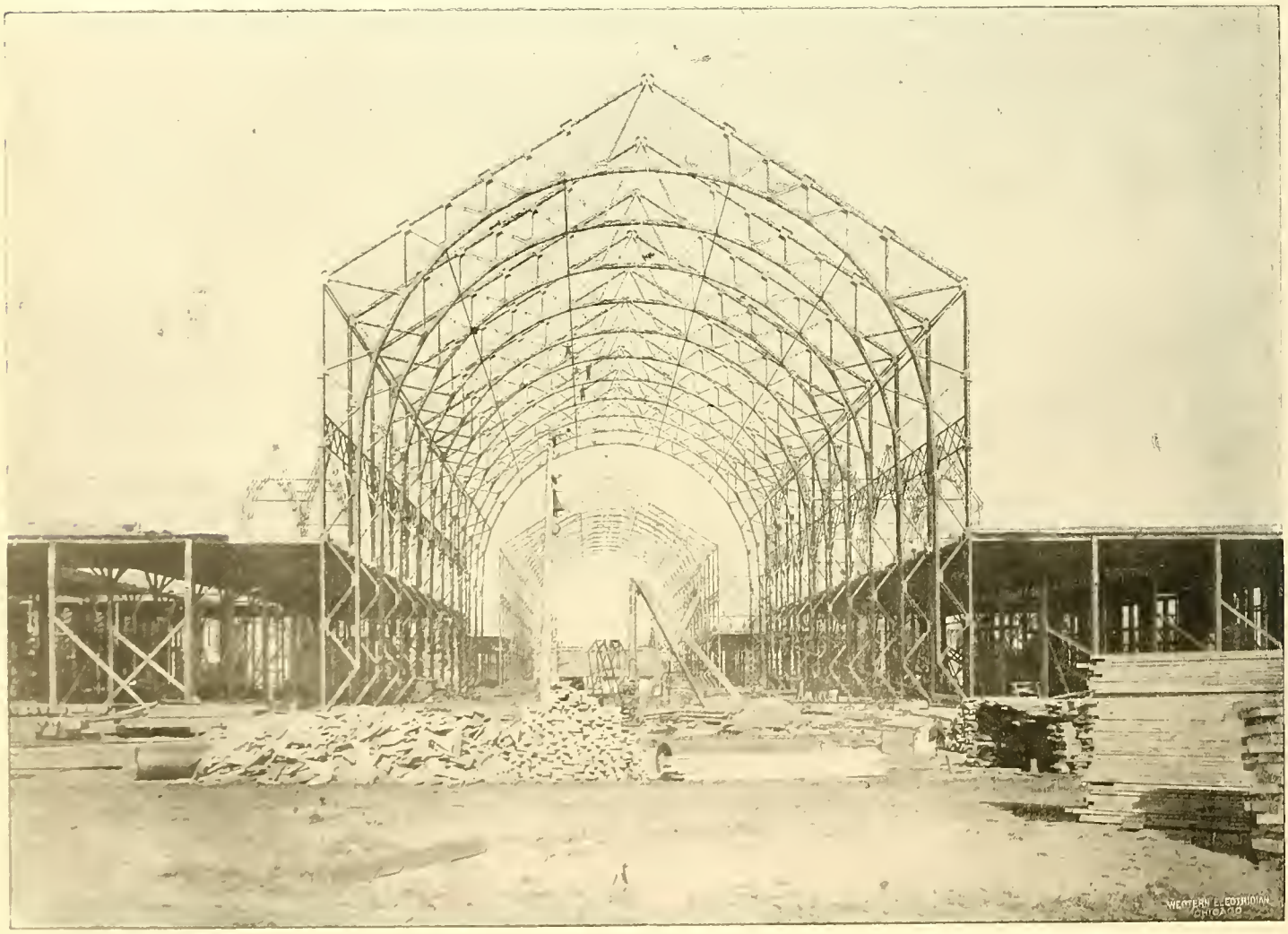
Going farther north and down the central aisle the displays which are most prominent are those of the American Bell Telephone company and the Westinghouse company. The telephone booth is an example of the purest type of Greek architecture throughout, and the exterior and interior decoration follow this idea to the minutest detail. In it will be shown the telephone from its infancy to the present day, including a model central station. A small theatorium will give an opportunity to test the loud-speaking telephone in connection with the long-distance circuit from Boston. Concerts in New York and Boston will thus be heard in the electricity building.

The Westinghouse company will show railway appliances of all kinds, as well as the alternating apparatus of the company. A feature will be the display of mining apparatus with a generator operated by a Pelton water-wheel. An electric pump operated by a motor will furnish water to the wheel, which will in turn operate the generator. It will be an unique exhibition of the possibilities of the use of electricity. In section J a magnificent

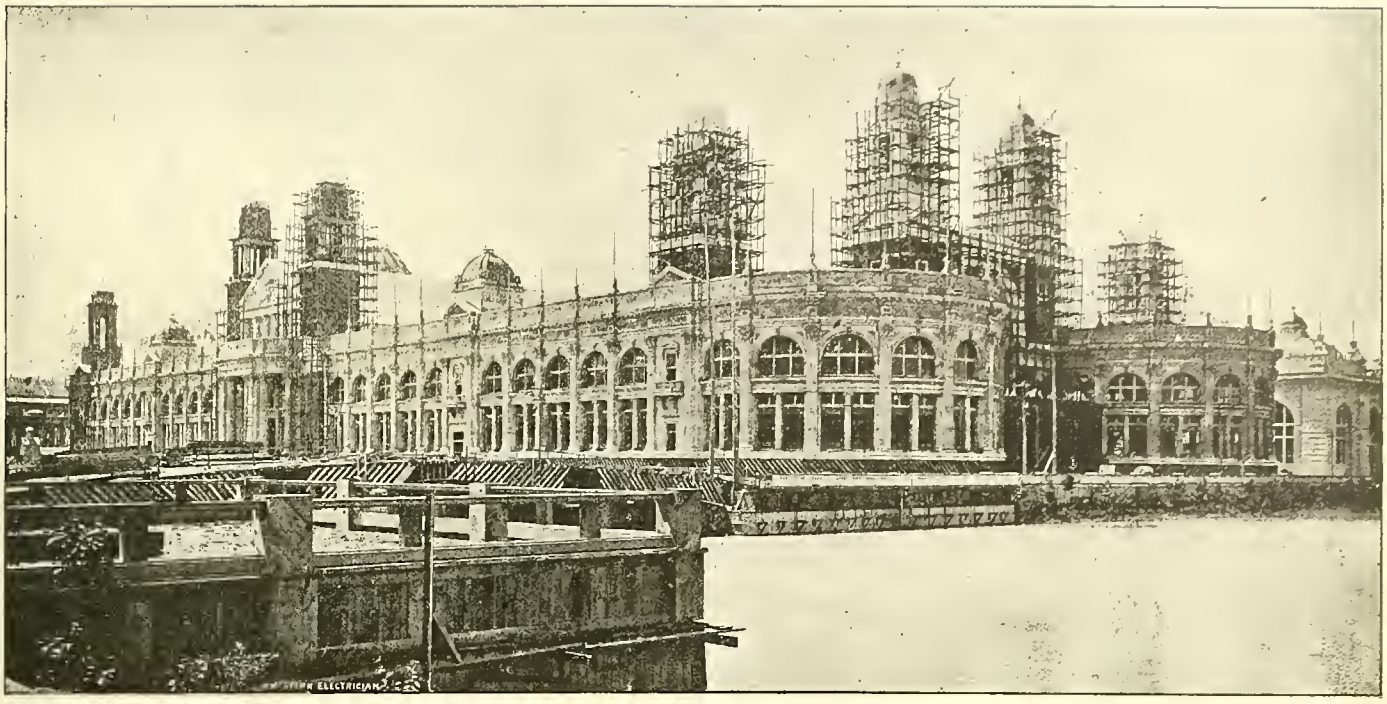
MACHINERY HALL.



SKETCH OF ELECTRICITY BUILDING.
(Western Electrician, May 9, 1891.)



ELECTRICITY BUILDING IN COURSE OF CONSTRUCTION.
(Western Electrician, February 9, 1894.)



ELECTRICITY BUILDING BEFORE THE DEDICATORY EXERCISES.
(WESTERN ELECTRICIAN, September 3, 1892.)

ELECTRICITY BUILDING COMPLETED.

structure will be erected which will be dazzling with its myriad display of incandescent lights. It will reach a height of forty feet and will be a notable object in the central nave.

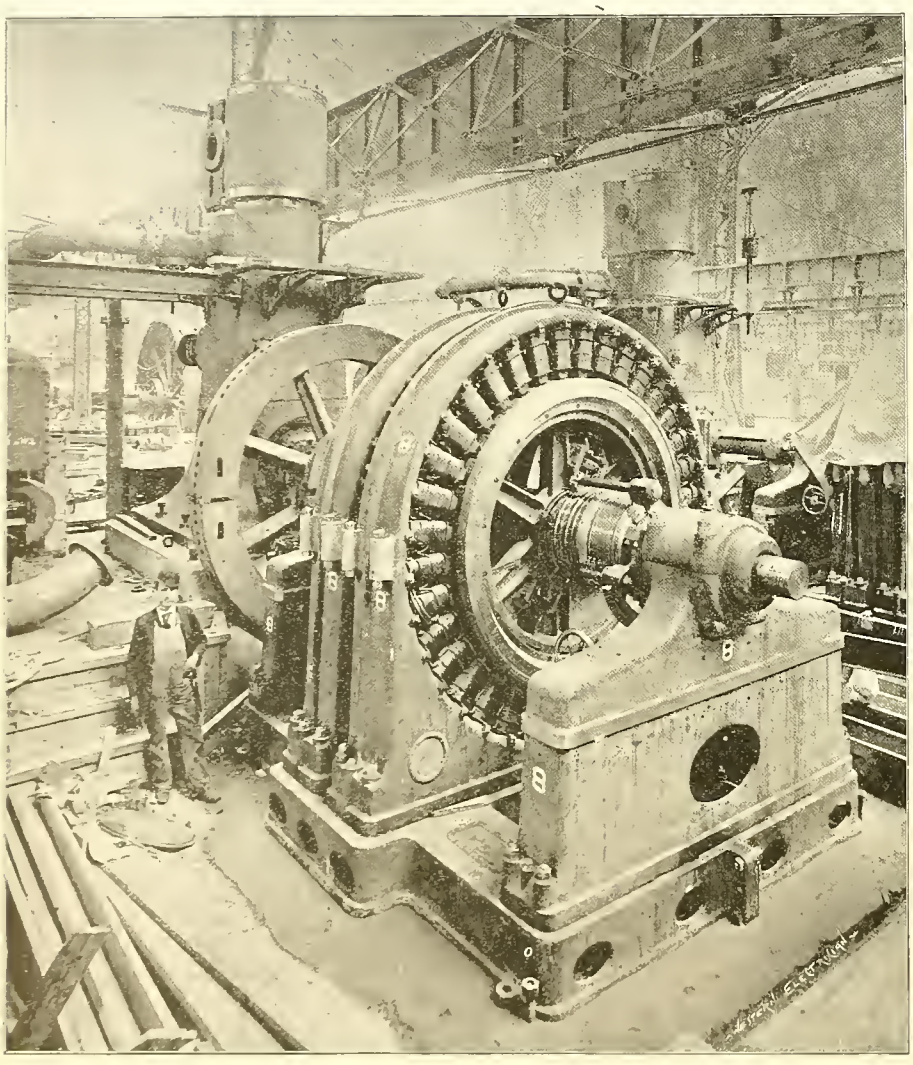
The gallery floor will have a great number of exhibitors, all of whom will make more or less interesting displays. Of the foreign governments, Germany will again take the lead. The northeast part of the gallery will be filled with exhibits of a light character. In the east central nave will be the historical display magnificently decorated. It will be the history of Dr. von Siemens for, as Dr. Lobach remarked, "the history of Von Siemens is the history of electricity in Germany." Another interesting exhibit is the "Schnellsehr" or "Tachyscope" of Berliner. It is the twin brother of Edison's Kinetoscope, but Edison goes a step farther and adds the phonograph, giving us the Kinetograph.

Spain will show the operation of its military telegraph. Italy will make a small but valuable exhibit, as will also Great Eastern, thus showing the inception and progress of the Atlantic cable.

Elisha Gray will show his telautograph, which has already been described fully in these columns. N. L. Holmes shows an electric dining-room service, thus doing away with the dining-room waiter. W. R. Brixey has a handsome display in white and gold, one of the prettiest pieces of work in the gallery. Dr. A. H. Phelps will show a new process of engraving on glass by electricity, something new in that line and completely revolutionizing the old methods of doing such work.

The Republic of Brazil is the only South American republic represented in the electricity building, and it will make an interesting exhibit of government telegraph.

The outside displays, the electric fountain, the intramural railway and the electric launches form part of the electrical exhibition at the fair, but they need no special mention here, as they are described elsewhere. Only one outside display needs notice and that is the exhibit of



DIRECTLY CONNECTED WESTINGHOUSE 1,000 HORSE POWER ENGINE AND 10,000 LIGHT ALTERNATOR, MACHINERY HALL.

Austria and New South Wales. Among other displays on this floor may be mentioned those of the Western Union Telegraph company, the Commercial Cable company, W. R. Brixey, the Chicago Electric Wire company of Wilmington, Del., Dr. A. H. Phelps, N. L. Holmes, McIntosh Battery & Optical company and the North American Phonograph company. The latter will be in a great measure the personal exhibit of Edison. Here will be shown the phonograph, from its inception down to a machine capable of reproducing a grand opera in its entirety.

Edison's latest invention, the kinetograph, will be the feature of the exhibit and probably the sensation of the exhibition, just as the phonograph was at the Paris exposition.

The Commercial Cable company will show the progress and workings of the modern cable, with a model of the cable steamer "Mackay-Bennett." The Western Union Telegraph company's display will be the history of telegraphy from Morse to Edison, showing the original apparatus of Morse of 1837 and 1844 and the latest quadruplex instruments. The Field collection of maps, data and apparatus will be shown as well as a model of the Schnuckert & Co. of Nuremburg, of search lights. One of these, a six-foot projector, will be on the manufactures building. It has an actual candle power of 60,000, and this light is condensed into a beam which will have a candle power of 180,000,000. This light could, if placed at a sufficient altitude, illuminate Milwaukee so brightly that the finest print could be read on the darkest night.

Taken as a whole, electricity building will be probably the center of attraction, especially at night, and the exhibits therein will be found to be thoroughly representative of the industry and will illustrate the progress of the science in a way that will leave nothing to be desired.

The Boston & Montana Consolidated Copper & Silver Mining company of Great Falls, Mont., has recently put in operation its large electrolytic copper refinery. This plant is capable of turning out 1,200,000 pounds of pure electrolytic copper per month. The current used is generated by two multipolar Thomson-Houston dynamos of 165 kilowats capacity, and is transmitted from the power house to the tank room, a distance of 2,100 feet, through 21 half-inch copper wires. The total weight of copper connections used in the plant is over 55,000 pounds. The total cost of the plant, aside from real estate, etc., was over $350,000.

The Service Plant.

By R. H. Pierce.

The electrical service at the World's Columbian Exposition will form a working exhibit of every branch of the art in commercial use, and will be of great interest as representing what is newest and best in every branch, and at the same time showing, as has never been done before, the enormous resources of the electrical industries of this country. The whole service comprises complete installations of the following named systems:

Arc lighting.
Incandescent lighting.
Electric power.
Telephone service.
Police signal service.
Fire alarm service.
Telegraph service.
Electric transportation.

In addition there will be many minor and new applications of electricity. The reader will find elsewhere in this paper articles descriptive of the principal applications written by those who are familiar with all the details, and the writer will only attempt, briefly, to attract attention to the magnitude of the installation.

A fair idea of this may be obtained by a comparison with other expositions. At Paris in 1889 the total steam power devoted to electric lighting was 3,000 horse power. At Chicago the engines devoted to electric light and power in the main power plant alone aggregate 17,000 horse power, of which 3,000 horse power is devoted to the electrical transmission of power and 14,000 horse power to producing electric light. About 1,000 horse power in addition will be supplied for light by exhibitors in machinery hall and in small isolated plants. To this must be added, if the comparison is to be complete, the plant of the Intramural Railway company of about 5,000 horse power.

The electric lighting at the last Paris exposition was furnished by 1,150 arc and 10,000 incandescent lamps, giving a total of about 1,600,000 candle power. The lighting at Chicago will comprise about 90,000 incandescent lights of 16 candle power, or a total of 1,440,000 candle power, and about 5,100 arc lamps, with a total of 10,000,000 candle power—a grand total of about 11,400,000 candle power. The figures are not exact, as the demand for light is constantly increasing.

The total capacity of the electric plant is about 5,000 arcs of 2,000 candle power each and 120,000 incandescent lights of 16 candle power, so that there is a reserve sufficient to operate 30,000 incandescent or 3,000 arc lamps. It appears, then, that the plant is approximately between seven and eight times the size of all the plants at Paris. It is significant that while the lighting alone at Paris called for the formation of a syndicate of nearly all the leading companies—over twenty in all—the lighting at Chicago, with the exception of about 500 horse power, will be furnished from the standard apparatus of four leading American firms.

The most noticeable feature, and the one which especially shows the progress of the art, is the fact that here for the first time electricity is used almost exclusively for transmission of power. With the exception of power in machinery hall and a small proportion of the power in the mines and mining building, all the power which is transmitted will be furnished from the great power plant through wires and utilized by electric motors. Even in machinery hall lines of shafting will be driven by electric power. Already seventy five motors aggregating 1,300 horse power are placed or being placed for the use of the Exposition company alone, and electric power can be obtained by exhibitors in all buildings.

While the subject of electric power transmission is under consideration it may not be out of place to call attention to the service of electricity in building the exposition. From the very beginning of construction the temporary power plant, now no more, ran day and night seven days in the week, operating motors in the daytime which furnished power for the saw-mills, hoists, pumps and painting machines, and at night grinding out light, so that the construction could be carried on day and night where necessary, and the engineers and draughtsmen could lay out work for other days and nights. Electricity helped to prepare the material, to hoist the heavy beams and trusses, to paint the buildings, and at the same time to prolong the labors of the overworked engineer and mechanic and light the rough or muddy pathway of the Columbian Guard.

A few words must be devoted to a description of the arc lighting plant. But few arc lights will be sold, the entire

capacity of the arc machines being needed for general illumination. Of the 5,000 lamps used for this purpose about 1,600 will be used for illuminating the grounds, and of the other 3,400 nearly all will be used for lighting the main aisles of the exhibit buildings. The lights upon the grounds are hung upon fancy iron posts of special design, one single lamp upon each post, except at entrances and conspicuous points, where two and three light clusters are used. The lights are placed on roadways at distances varying from 75 to 100 feet, according to location, and so as to form straight lines in all cases. The lights about the buildings are all about 40 feet from the structure, where the streets allow this arrangement, thus forming an even lighting of both streets and buildings.

The larger buildings are lighted according to the plan shown in the following table:

NAME OF BUILDING.	NO. OF ARC LAMPS.	SYSTEM EMPLOYED.
Manufactures	1,200	Thomson-Houston.
Agriculture	500	Standard.
Transportation	350	Western Electric.
Horticulture	250	Wood.
Mines and Mining	200	Brush.
Fisheries	50	
Illinois State	77	
Machinery Hall	250	Mostly Standard.

Machinery hall annex will be lighted by 160 lamps of the General Incandescent Arc Light company, which will be run in series of ten from the power (500 volt) circuits. The terminal station and tracks will be lighted by arc lamps of 3, 6 and 9 amperes in series on the 440 volt circuit of the Siemens & Halske company of Berlin. Transportation annex will have 150 Helios arc lamps attached to the 105 volt alternating circuit of the Westinghouse company.

The arc lights in buildings will for the most part be suspended by steel wires from the roof, the lamps being hung on insulating hangers at such a height that they can be reached by trimmers from step-ladders. This arrangement has proved very satisfactory, as it does away completely with slack wires and forms a neat construction which is cheap to erect and easy to maintain. The aisle lights in machinery hall are suspended higher than elsewhere, so that they clear the electric cranes, from which they are trimmed. In special cases where the lamps are hung very high and in inaccessible places a special separable hanger will be used, so that the lamps can be lowered and raised without the use of slack wires.

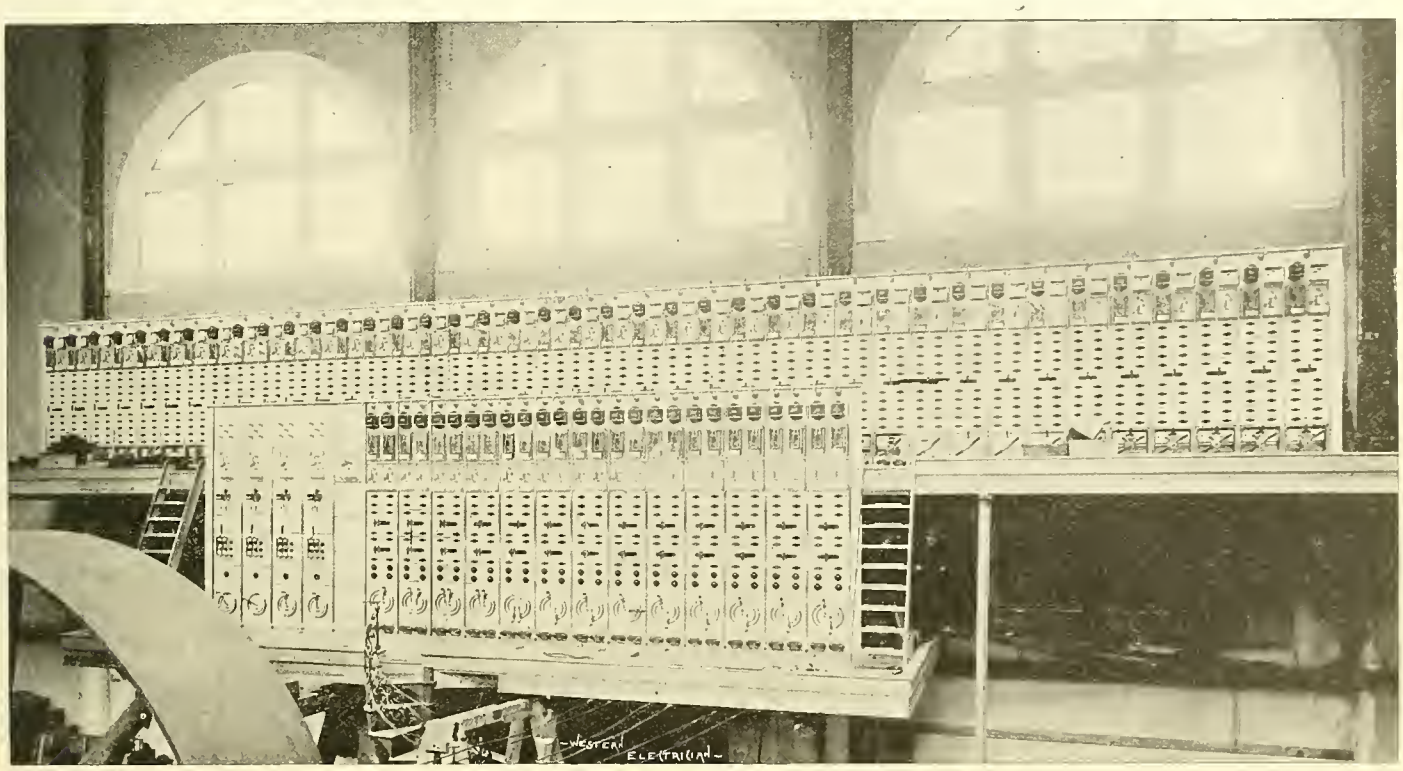
The crowning glory of the arc lighting is the lighting of the central nave in manufactures building. This is undoubtedly the most unique and beautiful piece of arc lighting ever attempted. This space, which is about 1,300 feet long and 368 feet wide, with a height of 202 feet in the clear, is lighted by five great coronas. These coronas are suspended 140 feet from the floor. The central corona is 75 feet in diameter and carries 102 lights; the other four, which are equally distributed along the main longitudinal axis, are 60 feet in diameter and carry 78 lights each, making a total of 414 two thousand candle power lights. The lamps are hung in two concentric circles. Although the coronas are in reality hanging galleries in which the lamp trimmer can walk at ease, they look light and graceful at the great height at which they are suspended, and the ladders by which they are reached from the great trusses would not be noticed by the ordinary observer. The effect of the lighting is fine beyond expectation. Opal globes are used on the lamps, as upon all the arc lamps in the great plant. These diffuse the light, and with the great spread of the coronas and the reflection from the arched roof the lighting is so uniform that the eye cannot distinguish any variation of intensity upon the floor or the exhibit pavilions.

The arc plant proper consists of five independent plants, each having its own switch-board. From the switchboards, which stand out upon the floor in their respective plants, the circuits run under the floor to a long gallery under a main aisle in machinery hall and annex. This gallery is an extension of the main electrical subway. From here they run to the principal buildings in the main subway, which is a tunnel about 7 feet high and varying in width from 4 to 16 feet. In the main subway the arc wires as well as all other conductors are carried upon petticoat insulators on oak cross-arms, so that we have in reality an underground pole line buried where it is safe from storms and falling trees and wires and where the lineman can stand upon the ground and reach any of the 300 conductors.

Leading west from the main gallery a trunk line of tile ducts leads to the outside of machinery hall and is continued by wooden ducts to the north, feeding the western half of the park. A network of ducts connects the trunk line of duct to the subway and runs to all outside lights. The power circuits run underground only in the subway. An idea of the power circuits may be obtained from the fact that they comprise over 35 miles of No. 0000 wire, beside miles of smaller sizes. The arc system comprises 90 miles of wire in the 75 miles of ducts, 50 miles of wire in the main subway, 130 miles of wire in buildings and overhead on structures. Although the smallest arc machine is a 50 lighter, there are 100 arc dynamos and an equal number of circuits.

Such in brief is the plant at Jackson Park. Although it is not the "ideal central station" of which we hear so much, it will prove an ideal exhibit of the resources of American engineering and the progress in electrical engineering.

Plans have been completed for a power station at the outlet of Huella Lake, in Sweden, where there is a large water power. At present four turbines, each of 100 horse power, will be put in, one of them to be held in reserve, in case of a break-down. The power will be transmitted by overhead wires to Grangesberg. The electric lighting station is six miles, and the station from which power will be distributed is eight miles, from the dynamo house.



WESTINGHOUSE SWITCHBOARD, MACHINERY HALL.

Edison Company's Strike Still On.

The aspect of the strike of the Chicago Edison company's wiremen has not changed materially in the last two weeks. Thirty per cent. of the total number of wiremen employed by the company have not returned, and electric installations on several buildings in process of construction have been abandoned for the present as a consequence. The company maintains, however, that it is not at all troubled by the strike and that it will fill existing contracts without delay. Last Thursday night a number of electrical contractors met at the Grand Pacific Hotel and formed an association to be called the Electrical Contractors' Association of Chicago. The officers are: President, W. L. Abbott; vice-president, W. S. Cornish; secretary and treasurer, T. J. Thompson, who, with L. K. Comstock and F. S. Gorton form the board of directors. It is the intention of this association, which at present includes about 30 electrical contractors, to set the specifications for wiring, etc., so high that all contractors in the city will be induced to join. It is claimed that the new association agrees to pay the rate of 37½ cents an hour, asked for by the men, and to make eight hours a working day.

No mention was made to working with non-union men, and whether the men will accept this proposition is a matter of serious question. The striking union has presented its claims before the Building Trades Council, with which it is affiliated, and this body has indorsed them. As the striking men practically refuse to work with non-union men, more serious trouble may result before an amicable settlement is finally made.

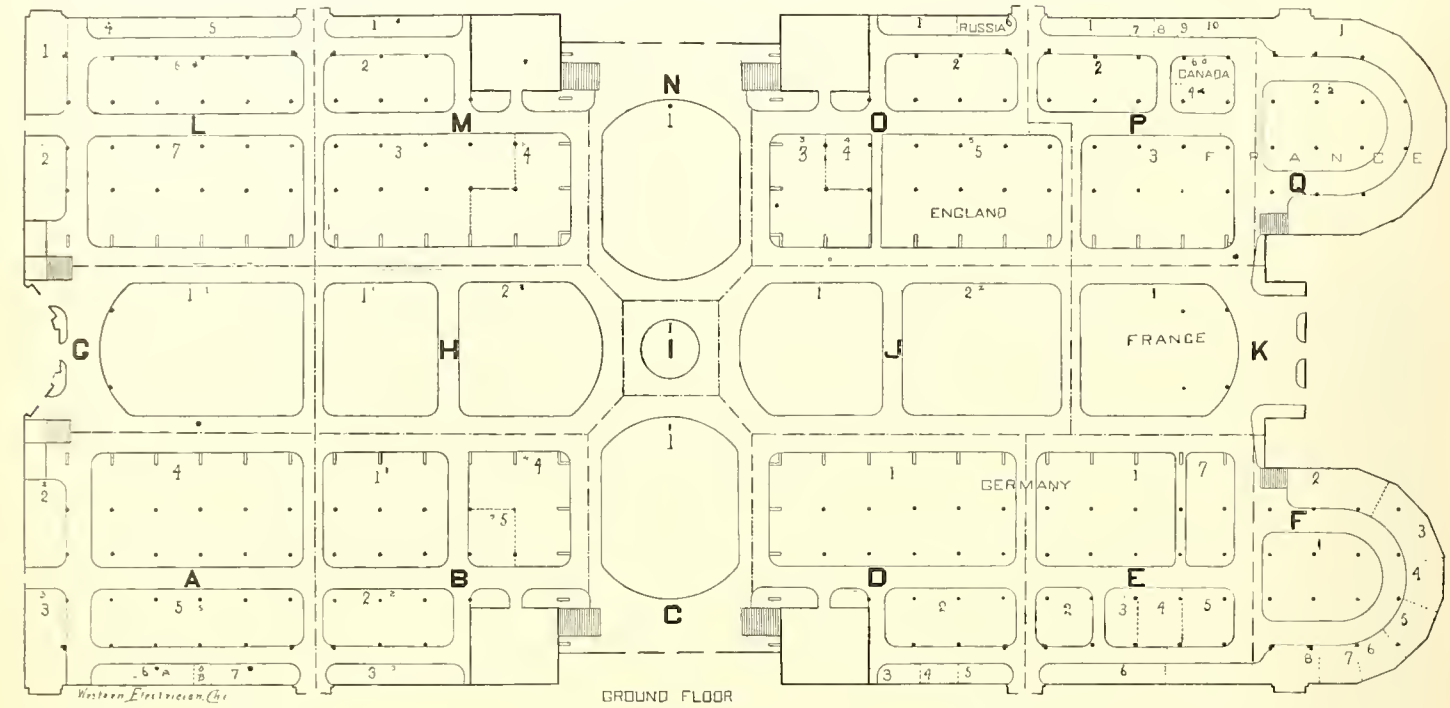
Van Depoele's Railway Patents.

The General Electric company announces that "after several years of contention and interference before the Patent Office, two broad fundamental patents have been granted to Chas. J. Van Depoele, covering all the essential features of the trolley. The patent is assigned to the Thomson-Houston Electric company. In detail, the claims allowed cover first, the underneath contact made either by a rolling wheel or a sliding spoon contact piece; secondly, the converse of these two cases, and thirdly, the reversibility of the trolley pole on top of the car enabling the contact to be made on either side of the trolley, as the case may be. The possession of this patent practically means, the entire control of the overhead system throughout the United States. This so far is the only system which has proved successful, no serious rivalry having yet been shown, by either the storage battery or the underground conduit. The acknowledgment of the claims, under this patent granted to the dead inventor, made by the Patent Office is an important victory for the General Electric company, which will most likely be followed by very important results to the entire street railway fraternity."

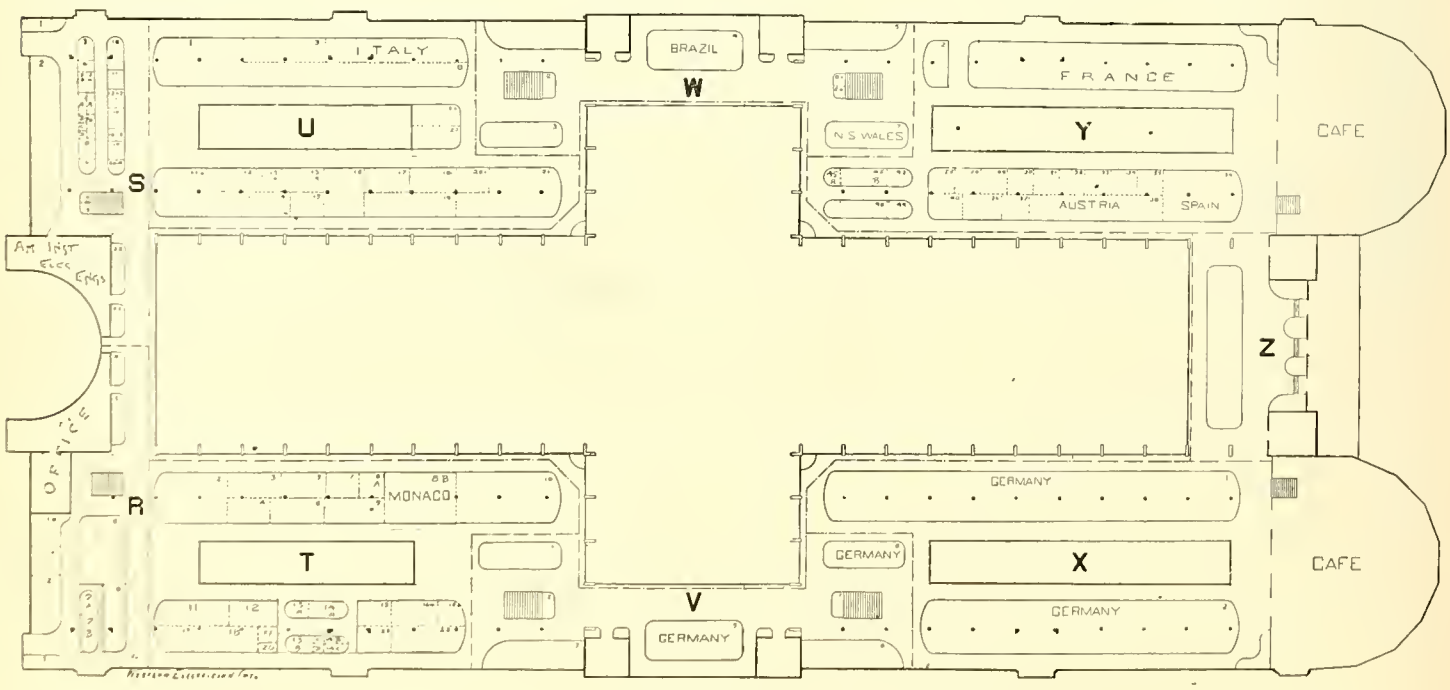
Exhibitors In Electricity Building.

Following is a complete list of American exhibitors in electricity building, taken from the official record, showing the location assigned each display:

A	7	Acme Filter company, St. Louis, Mo.
G	1	American Bell Telephone company, Boston, Mass.
S	14	American Graphaphone company, Washington, D. C.
T	9a	American Battery company, Chicago.
H	2	American Engine company, Bound Brook, N. J.
Z	1	American Electric Heating company, Boston, Mass
Z	1	Ansonia Electric company, Chicago.
M	1-2	Anthony Electrical Instrument company, Chicago.
Y	43	Bates Manufacturing company, Chicago.
		Baxter Electric Motor company, Baltimore, Md.
E	2	Belknap Motor company, Portland, Me.
H	2	Bemis Car Box company, Springfield, Mass.
	7a	Billings & Spencer company, Hartford, Conn.
F	7	Curtis Electric Manufacturing company, Jersey City, N. J.
T	3	Cutter, George, Chicago.
L	5	Degenhardt, F. E., Chicago.
L	4	Diamond Mills Emery company, Philadelphia, Pa.
A	7	Diamond Electrical Manufacturing company, Peoria, Ill.
R	5	Du Laney Clock company, Chicago.
D	2	Eco Magnetic Clock company, Boston, Mass.
B	3	Eddy Electric Manufacturing company, Windsor, Conn.
T	13d	Edgerton, E. M., Chicago.
J	1	Edison, Thomas A., Orange, N. J.
S	2	Edison Manufacturing company, New York
Z	1	Edwards & Co., New York.
D	2	Electrical Forging company, Boston, Mass.
Y	36	Electrical Machine company, Chicago.
U	16	Electrical Appliance company, Chicago.
P	1	Electrical Conduit company, New York.
S	21b	Electrical Specialty company, Denver, Colo
Y	28	*Electrical World*, New York.
M	3	Falls Rivet & Machine company, New York.
E	7	Fein, C. & E., Stuttgart, Germany.
U	15	Ford-Washburn Storelectric company, Cleveland, O.
M	3	Fort Wayne Electric company, Fort Wayne Ind.
S	23	Franklin Electric Appliance company, Boston, Mass.
T	10	Frere, De la, Malcolm, Minneapolis. Minn.
		Frisbie & Co., New Haven, Conn.
V	1	Gamewell Fire Alarm Telegraph company, Chicago.
Y	46	Gault & Co., N. C., Winona, Minn.
E	6	General Incandescent Arc Light company, New York.
C	1	General Fixture company, New York.
B	4	General Electric company, New York.
C	1	" " "
H	2	" " "
J	1	" " "
M	4	" " "
N	1	" " "
O	3	" " "
T	13a	Goldfuss, O. F., Chicago.



GROUND FLOOR



GALLERY

DIAGRAMS SHOWING ALLOTMENT OF SPACE IN ELECTRICITY BUILDING.

A	4-5	Briggs, Orlando, 227 South Clinton street, Chicago
T	2	Birney, W. K., 203 Broadway New York.
L	4-5	Brush Electric company, Cleveland, O.
T	17	Bryant Electric company Chicago
A	7	Burton Electric company, Richmond, Va.
A	2	C. & C. Electric Motor company, New York.
A	7	Campbell Electrical Supply company, Boston.
R	7	Carpenter Enamel Thermostat company, Bridgeport, Conn.
H	2	Case Engine company, J. T., New Britain, Conn.
	2a	Casper, Louis, Cheyenne, Wyo.
		Central Electric company, Chicago.
F		Chicago Belting company, Chicago.
T		Chicago Electric Wire company, Wilmington, Del.
A		Cleveland Electric Manufacturing company, Cleveland, O.
I	6	Coburn Electric Manufacturing company, Pittsburg, Pa.
	2	Commercial Cable company New York
F	4	Commercial Electric company Indianapolis, Ind
R		Consolidated Electric Storage company, Philadelphia.
T		Cooper Electric Heater company, Chicago.
S	7a	Cosmopolitan Automatic Fire Alarm company, Chicago.
U	13a	Crowell Gardner, Brooklyn, N. Y.
		Crane Elevator company, Chicago.
L	1	Crocker Wheeler Electric company, New York
Y	27	*Electrical Industries* Publishing company, Chicago.
Y	30	*Electrical Engineer*, New York.
Y	33	*Electrical Review*, New York.
Y	32	*Electricity* Newspaper company, New York.
U	19	Electric Selector & Signal company, New York.
T	14c	Electric Heat Alarm company, Boston, Mass.
W	1	Electric Advertising & Display Manufacturing company, Philadelphia, Pa.
S	7c	Electric Medical Battery company, Kalamazoo, Mich.
T	13b	Electric Gas Lighting company, Boston, Mass.
Z	1	Electric Manufacturing company, Dayton, O.
		Electric Launch & Navigation company, New York.
Z	1	Electric Thermostat company, Minneapolis, Minn.
O	2	Electric Pipe Bending company, Harrison, N. J.
T	8b	Electric company, Canton, O.
P	4	Elektron Manufacturing company, Springfield, Mass.
T	13f	Elgin Acoustic Telephone company, Elgin, Ill.
E		Elwell-Parker Electric Construction company of America, Chicago.
U	16	Emerson Electric Manufacturing company, St. Louis, Mo.
S	19	Empire China works, Brooklyn, N. Y.
U	14	Eureka Tempered Copper company, North East, Pa.
E	5	Excelsior Electric company, New York.
N	1	Goulds Manufacturing company, Seneca Falls, N. Y.
A	4-5	Granton & Knight Manufacturing company, Worcester, Mass.
W	5	Gray, Elisha, Highland Park, Ill.
F	8	Greeley, E. S., & Co., New York.
T	18	Grier, Thomas G., Chicago,
H	2	Griffin Wheel & Foundry company, Chicago.
T	4	Guillaume, Alfred, Chicago.
U	17	Hall, Chas. F., Chicago.
L	4	Hanson & Van Winkle, Chicago.
T	13b	Hanson Battery, Light & Power company, Washington, D. C.
S	15	Healy & Millet, Chicago.
S	17	Hirleman, Charles J., 117 MacDougale street, New York
O	4	Hirsh, Dr., Chicago.
V	1	Holmes, N. L., Ann Arbor, Mich.
Z	1	Holtzer Carbon Electric company, Boston, Mass.
S	16	Hope Electric Appliance company, Providence, R. I.
S	13	Hurd, John F. Chicago.
U	16	Indiana Rubber Insulated Wire company, Johnsboro, Ind.
S	11	India Rubber Comb company, New York

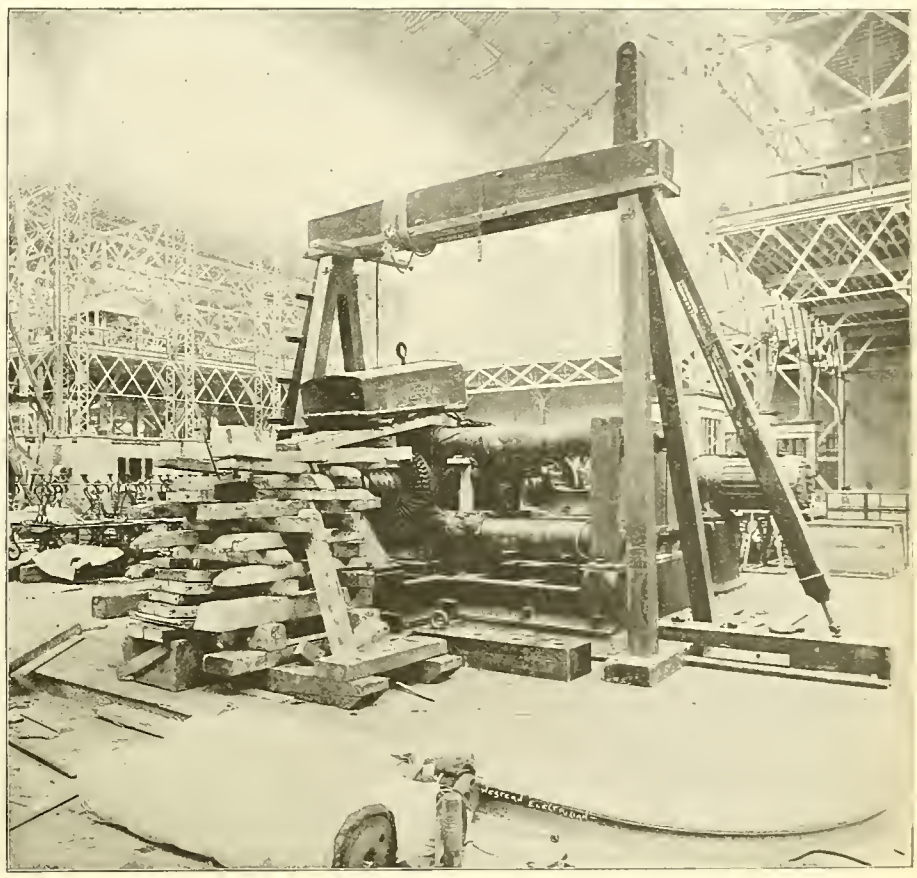
T	14c	Illinois Alloy company, Chicago.
Z	1	India Rubber & Gutta Percha Insulation company, New York.
N	1	Ingersoll-Sargent Drill company, New York.
U	3	International Automatic Light & Power company, Chicago.
H	2	Jackson-Sharpe company, Boston, Mass.
T	19	Jaeger, Chas. L., Maywood, N. J.
L	2	Jenney Electric Motor company, Indianapolis, Ind.
F	6	Jewell Belting company, Hartford, Conn.
H	2	Jewett Supply company, Boston, Mass.
U	21	Johns Manufacturing company, New York.
V	2	K. A. P. Electric Novelty company, La Crosse, Wis.
S	10	Knapp & Buckley, Chicago.
T	16b	Knight Coin Controlled Automatic Boot Black company, Chicago.
H	2	Lake Erie Engineering works, Buffalo, N. Y.
N	1	Lawrence Machine company, Lawrence, Mass.
Y	45b	Lawton, Harry A. and Kennon Mott, Brunswick, Ga.
V	7	Leclanche Battery company, New York.
S	20	Lee, Chas. E., Chicago.
H	2	Lidgerwood Manufacturing company, New York.
S	6a	Marcus, Wm. N., Philadelphia, Pa.
E	5	Mather, A. C. Chicago.
M	1-2	Mather Electric company, Manchester, Conn.
U	11b	McCaskey, Alfred S., and J. A. Ellis, Chicago.
W	3	McIntosh Battery & Optical company, Chicago.
H	2	McIntosh, Seymour & Co., Auburn, N. Y.
Y	35	McNeill Tinder Electric company, Winchester, Ky.
S	7b	Meeker, Dr. C., Newark, N. J.
D	2	Merrill Bros., Brooklyn, N. Y.
W	2	Meywortz, E. B., New York.
D	5	Munson Belting company, Chicago.
U	12	Munson Lighting Construction company, Indianapolis, Ind.
R	6	Murphy, T. J., New York.
E	4	Murray, Jas. J. & Co., Philadelphia, Pa.
A	3	National Automatic Fire Alarm company, New York.
T	14a	National Carbon company, Cleveland, O.
L	5	National Conduit Manufacturing company, New York.
S	8	National Engraving Machine company, Chicago.
Z	1	National Electric Manufacturing company, Milford, Conn.
Y	40	Newman Clock Manufacturing company, 279 Dearborn street, Chicago.
H	2	New York Air Brake company New York.
Y	34	New York & London Electric Association, Kansas City and New York.
U	16	New York & Ohio company, Warren, O.
T	11	New York Insulated Wire company. New York.
S	12	North American Electric company, New York.
S	2	North American Phonograph company, Chicago.
T	16a	Norwich Insulated Wire company, 44 Broad street, New York.
U	8	Okonite company, New York.
A	4-5	Orling, A. J., Chicago.
		Otis Bros. & Co., New York.
T	1	Owen, Dr. A., Chicago.
D	5	Page Belting company, Chicago.
U	22	Paiste, H. T., Philadelphia, Pa.
P	3	Pass & Seymour, Syracuse, N. Y.
N	1	Pelton Water Wheel company, San Francisco, Cal.
A	4-5	Pendleton Glass Tube and Pipe Works, Pendleton, Ind.
Z	1	Pfund, Richard, New York.
U	20b	Phelps, A. H., M. D., Glens Falls, N. Y.
I	1	Phoenix Glass company, Pittsburg, Pa.
U	16	Platt, O. S., Bridgeport, Conn.
V	1	Police Telegraph & Signal company, Chicago.
U	18	Powell, Wm., company, Cincinnati, O.
U	11a	Pratt Electric Medical Supply company, Chicago.
Y	45a	Pulver Macher Galvanic company, Cincinnati, O.
T	6	Pumpelly, Jas. K., Chicago.
E	7	Queen, Jas. W. & Co., Philadelphia, Pa.
F	1	Railway Equipment company, Chicago.
Z	1	Rnudd, Otto New York.
T	20	Rauscher, John, St Paul, Minn.
T	5	Reliance Gauge company, Cleveland, O.
R	1a	Ringler, F. A. & Co., New York.
H	2	Robinson Electric Truck & Supply company, Boston, Mass.
P	2	Rockford Electric Manufacturing company, Rockford, Ill.
S	9	Rosseller & Hasslacher Chemical company, New York.
		Rowell Potter Safety Stop company, Boston, Mass.
A	4-5	Russell & Co., Massillon, O.
D	3	Schieren & Co., Chas. A., Chicago.
S	5	Searing, Geo. S , 430 North State street, Chicago.
		Self Winding Clock company, New York.
L	6-7	Short Electric Railway company, Cleveland, O.
A	6p	Sloss Electric Gaslight & Specialty company, Chicago.
		Smith Pneumatic Transfer & Storage company, Chicago.
A	4-5	Sosman & Laudiem, Chicago.
T	13c	Sponholz, Carl L., Lowell, Mass.
O	1	Standard Electric company, Chicago.
P	2	" " "
T	18	Standard Paint company, Chicago.
L	5	Standard Underground Cable company, Pittsburg.
Z	1	Stanley Electric Manufacturing company, Pittsfield, Mass.
Z	1	Star Electric Pump company, Chicago.
R	8	Star Iron Tower company, Ft. Wayne, Ind.
N	1	Steam Stone Cutter company, Rutland, Vt.
H	2	Stephenson & Co., John, New York.
R	7b	Stevens, N. P., Concord, N. H.
Y	29	*Street Railway Journal*, New York.
S	6c	Striemer, A., South Superior, Wis.
T	7	Strowger Automatic Telephone Exchange, Chicago.
T	22	Storey, J. E., Boulder, Colo.
Y	37	Tate, D. D., 269 West Van Buren street, Chicago.
H	2	Taylor Electric Truck, company, Troy, N. Y.
A	7	Taylor, Goodhue & Ames, Chicago.
O	2	Thomson Electric Welding company, Boston, Mass.
S	4	Todd Applegate company, Chicago.
F	3	Union Electric company, New York.
T	23	Union Electric Works, Chicago.
R	4	Utica Electric Manufacturing & Supply company, Utica, N. Y.
U	16	Vail, W. A., New York.
R	6	Van Nuis, C. S , New York.
W	2	Vetter, J. C. & Co , New York.
A	7	Wagner Electric Manufacturing company, St. Louis, Mo.
U	26	Waite & Bartlett Manfacturing company, New York.
H	2	Walworth Manufacturing company, Boston, Mass.
V	3	Washburn & Moen Manufacturing company, Worcester, Mass.
Y	44	Webb, C. F., Dr., Cleveland, O.
N	1	Webster Manufacturing company, Chicago.
A	4-5	Western Electric company, Chicago.
Y	31	Western Electrician, Chicago
V	8	Western Union Telegraph company, Chicago.
B	1-2	Westinghouse Electric & Manufacturing company, Pittsburg, Pa.
H	1	Westinghouse Electric & Manufacturing company, Pittsburg, Pa.
J	2	Westinghouse Electric & Manufacturing company, Pittsburg, Pa.
R	6	Weston Electrical Instrument company, Newark, N. J.
H	2	Wharton, Wm. Jr., & Co., Philadelphia, Pa.
U	27	White Dental Manufacturing company, E. S., Philadelphia, Pa.
E	7	White, James, Glasgow, Scotland.
U	16	Whitney Electrical Instrument company, Boston, Mass.
A	6a	Wilder Duplex Electric Burglar Alarm & Messenger company, Chicago.
P	10	Wing, L. J. & Co., New York.
S	7b	Wullweber & Co., O. L., Chicago.
F	2	Zucker & Leavitt Chemical company, 14 Grand street, New York.

Model Incandescent Lighting Plant.

By E. E. Keller.

The important work of providing a complete installation for the incandescent electric lighting for the entire exposition, as well as a good share of the arc lighting and the electric power service, was placed in excellent hands when the contract for this work was made with the Westinghouse Electric & Manufacturing company. The contracts have been carried out to the letter; many details and refinements having been added beyond what was called for, and the entire plant, including everything from the lamps to the engines, has been designed and built in the most thorough manner conceivable, in view of the short time available for completing the work.

On June 8, 1892, a contract was drawn up for this immense incandescent lighting plant. This contract, however, was not signed and completed until the latter part of June, when active preparations were begun at once. Since that time, all plans have been made, including entirely new designs for the dynamos, and the whole of this colossal work completed.



PUTTING "JUMBO" TOGETHER, ELECTRICITY BUILDING.

Work was started at once, upon the completion of the contract by designing a suitable system of underground conduits and converter pits etc. On July 1st the conduits and manholes were laid in the surroundings of the woman's building, which was then practically complete, and the grounds surrounding it ready for the landscape gardener. The contract called for the completion of all underground work by September 1st, and this was practically accomplished by the New York Insulated Wire company, to which the Westinghouse company had awarded a sub-contract for all the construction work outside of the central station in machinery hall. The vast work of wiring the large buildings was taken up as fast as they reached a sufficiently advanced stage to work in them to advantage. In many cases, however, this could not be done, owing to the fact that the nature and location of the lighting was not decided upon by the exposition, and, in the case of purely exhibit buildings, the wiring could not be begun until exhibitors had decided what lighting they wanted. This naturally caused vexatious delays; the first plans for the lighting of exhibit spaces not being received until the last week in March. At this time the wiring for about 50,000 incandescent lights had been practically completed, so that the work of wiring for exhibits could be pushed rapidly forward, although it was an utter impossibility to complete everything, as applications are even now coming in, and exhibitors will probably order lights and changes for some weeks to come. It is notable that, although the wiring is only to be used for six months, it is all done so thoroughly that one will be unable to find very many installations in America that will compare favorably with it. The form of construction adhered to throughout is of the very best.

All lighting is controlled from closets located at convenient points in the buildings, where most of the switches and all of the fusible cut-outs are placed. The wiring was so planned that not more than twelve lamps are dependent upon one cut-out, and, where it was possible, the circuits were so arranged that only part of the lights in any one location would be affected in case of trouble. All wires, no matter where located, can be reached without any delay, as the running of wires in inaccessible places was strictly avoided. In all cases the wires are led to and from the cut-out closets in mouldings or iron pipe, excepting in places where they could be run on glass insulators through roomy spaces in the hollow walls, where a permanent means of access to these hollow spaces was always provided. Where hollow spaces could not be made accessible, or where they were too narrow, iron pipe inside, or wooden mouldings outside the walls were resorted to, over three hundred miles of pipe and mouldings being used for this purpose alone. Where iron pipe was used, both legs of the secondary circuits were invariably run in the same pipe to guard against self-induction. The secondary wiring for the installation has been planned and installed for a drop of three per cent. with a variation of not over two per cent. between any two lamps on the grounds, and the uniformity of the lighting shows how well this was done. In order to avoid the errors that would have occurred had the common method of determining the direction, location and sizes of wires been adhered to, it was made an inviolable rule that no wiring should be erected without a complete detail drawing. In every case, all necessary calculations and drawings were made in the office, giving the foreman all required information, thus securing a uniform construction and a permanent record for future reference in case of trouble. A thorough system of inspection was maintained throughout the work, both on the part of the exposition and the contractors, with the result that remarkably little trouble was encountered after the completion of the wiring.

The primary system of this entire plant is underground, not a single wire being overhead, with the exception of that portion of the grounds located south of machinery hall

and agricultural building, where it was decided to use overhead construction owing to the nature of the buildings and exhibits in this section. In this portion of the grounds, the wires are carried partly on the structure of the electric elevated railroad and partly on a pole line.

The circuits for the main portion of the grounds leave the station by means of lead covered duplex cables of the Standard Underground Cable company, passing through vitrified ducts to a fire-proof room at the side of the main subway located under the floor of machinery hall. Here some of the lead cables end in rubber terminals, and to these are joined Grimshaw wires with 125 mils of rubber insulation going to the eastern portion of the grounds by way of the large subways in which the wires are strung on cross-arms and glass insulators. In this subway, which has been frequently described in the electrical journals, the wires are carried five inches apart to the administration, mines and mining, electricity, manufactures and liberal arts, government and fisheries buildings. From the latter point, the circuits going north to the various state and foreign buildings are again joined to lead-covered duplex cables and carried in wooden conduits. In the circuits going to the western portion of the grounds, lead-covered cables are used throughout, the cables being laid on the floor as the main subway until the north wall of machinery hall annex is reached, when they are carried in wooden ducts composed of pump logs. Wherever the circuits and laterals leave the main subway, a duplex lead covered cable is joined to the rubber covered subway wires and is carried to its destination by means of pump logs, a vitrified pipe being used in cases where buildings are entered. This system of primary wires is connected to special converters of the Westinghouse type, most of which are of thirteen kilowatts capacity, there being some of 6,250 watts and some of 2,000 watts capacity. All of these converters are placed in ventilated pits of special design located at most convenient points. These converter pits are built of wood with a galvanized iron lining so arranged as to exclude moisture and still permit of thorough ventilation. Primary fuse blocks of special design were placed in the pits, there being no fuses in the converters. These primary fuse blocks are designed to also fill the place of a primary switch, so that any or all converters in the pit can be disconnected from the primaries for testing or repairs. The secondary fuses are placed in closets inside of the building. Each converter is connected to a separate secondary circuit, and these circuits are each supplied with a main switch placed in the cut-out closet. Converters are in no case "banked."

Besides the incandescent lighting furnished from this system of primaries, there are over a thousand arc lamps operated in all parts of the grounds from the same wires. The arc lamps used for this work are partly of Westinghouse manufacture and partly of the manufacture of the Helios Electric company of Philadelphia. All of these lamps are operated from what are termed Westinghouse "economy coils," which permit of one, two or three arc lamps being connected across the 105 volt terminals of the secondary system, without resistance coils being required to absorb the current of lamps not burning in the series. These "economy coils" are placed in convenient locations in the buildings. The lamps are designed for fourteen amperes at thirty-five volts pressure.

In several locations it was found necessary to operate motors where the 500 volt power circuits were not available, and in these places two-phase alternating current motors are connected to the system. Where fan motors and other small motors are required, they are simply connected to the secondary lighting circuits, an ordinary alternating current motor being used.

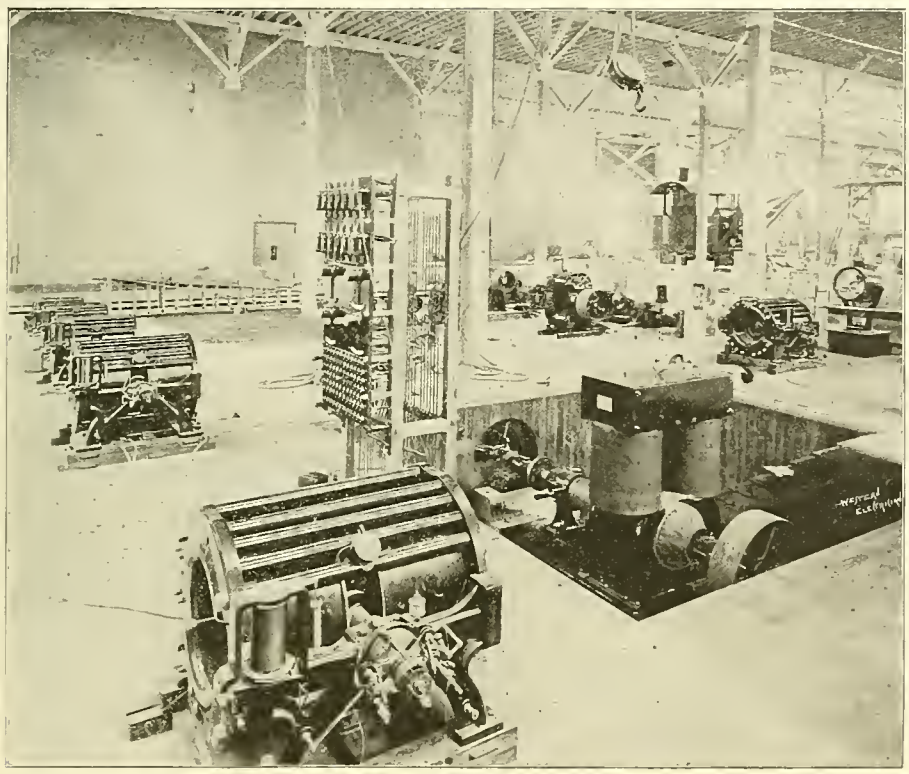
Besides this work, the Westinghouse company furnishes a novel system of lighting for the buoys that have been placed along the shore of Lake Michigan, for a distance of seven miles, from the Chicago river to the main pier at the exposition grounds, by the United States government. For this purpose thirteen spar buoys have been placed at points along the shores to indicate the shoals. Each buoy carries an incandescent lamp of 100 candle power in a wrought iron cage or lantern at the upper end of the spar, the lower end of which is fastened to a heavy cast-iron anchor. The current for each of these lamps is supplied from a small Westinghouse converter, of special design, placed in the upper end of the spar. These converters are connected in series, the current for the entire series being obtained from a special Westinghouse converter of 1,400 volts. This large converter is placed at the outer end of the main pier at Jackson Park, where all necessary switches, fuses, regulating devices and Wurts non-arcing metal lighting arrestors are also placed. For this work a single wire Bishop gutta percha submarine cable is laid from the pier to the first buoy; from there to the second, and so on. From the last buoy at the city the cable returns by the most direct route to the pier at Jackson Park. On the whole, this system of lighting buoys promises to come into extended use for harbors along the seacoast.

The central station supplying current to this entire system of incandescent lighting, arc lighting, and power service is well worth several days' study on the part of any one interested in work of this character. When the contract for this work had been secured, it was at once decided that the scope of the work required something out of the ordinary line of generating apparatus, and plans were made for an entirely new type and size of dynamo. It can be imagined that this called for energetic action on the part of the company's engineers at Pittsburg and the carrying out of the work night and day in the factories. The result of the tireless energy displayed is a station of a very simple and practical character, considering its size. This lighting plant is located in what is known as the power plant, a stretch of space 100 feet wide along the south wall of machinery hall next to the boiler house. There are twelve two-phase alternating current dynamos of a capacity to supply 15,000 50 watt lamps each, and two single phase dynamos of 4,000 lights capacity each, also one 700 horse power 500 volt continuous current generator. Six of the twelve large dynamos are coupled direct to Westinghouse compound engines of 1000 horse power, specially designed and built for this work. The other six dynamos are belted directly to engines of different manufacturers. These dynamos operate at 200 revolutions per minute with a frequency of 7,200 alternations. In the space directly opposite the main entrance of machinery hall and in the center of the south portion, is a space about 100 feet square in which an E. P. Allis company's Reynolds-Corliss quadruple expansion engine of 2,500 horse power drives two large dynamos in tandem. In this same space is a Corliss engine of 1,000 horse power capacity built by Fraser & Chalmers, which drives another of these dynamos. Besides these three large dynamos, there are three direct coupled dynamos of the Westinghouse railway generator type of 100 horse power each, wound for 250 volts, and used as exciters for the entire plant. Here also are the two 4,000 light machines driven by belts from two Westinghouse compound engines of 350 horse power each. In the space next west of this, which is only 42 by 97 feet, are located four of the direct coupled dynamos, showing the remarkable saving in space effected by the use of this type of engine and method of coupling. The engines in this space are of entirely new design, and are among the first high speed engines of this capacity built in America. They are vertical compound condensing, with the low pressure placed above the high pressure cylinder, the crank, connecting-rod, etc., being entirely enclosed and running in oil, as in the single acting type of Westinghouse manufacture. The governor, operating in an oil case, is of the same general type as the one used in single acting engines. The shaft makes 200 revolutions per minute and carries a fly-wheel eleven feet in diameter, weighing twelve tons. It is coupled to the dynamo shaft by a flexible coupling without insulation. In the space just west of these generators are located the remaining belt driven machines. These have pulleys nine feet in diameter, and are driven by seventy-two inch belts from McIntosh & Seymour, Atlas, and Buckeye engines of 1,000 horse power each. These engines are all compound and run with condensers. In the space directly west of these engines are located the last two dynamos, which are also driven direct from two of the new 1,000 horse power Westinghouse compound engines. The 700 horse power generator supplying part of the exposition power service, is located just east of the incandescent lighting plant. This is driven by a cross-compound Reynolds Corliss engine of 700 horse power capacity, the armature being between the two engines on the same shaft. The fields of this large generator are so designed as to slide away from the armature to allow of repairs to any part without lifting, unless there should be trouble in the bearing. This machine furnishes current to the general power distribution system in the grounds.

All of the incandescent machinery in this plant is controlled from a single switch-board, which is by far the finest piece of work of this character that has ever been carried out. It was deemed inadvisable to place switch-boards at different parts of the extensive space covered by the machinery, principally for want of floor space. To gain space and to have the switch-board attendants in a location where their attention would not be so frequently called from their work, it was decided to place the entire switch-board on specially designed galleries. These switch-board galleries are placed against the south wall of machinery hall immediately in the main center. The lower gallery is twenty feet wide and forty feet in length. On this gallery is placed the dynamo switch-board. This board is composed of thirteen panels for the alternators, four panels for four 100 horse power generators used as exciters and one general exciter panel. Twelve of the alternator panels are used for the twelve generators, the thirteenth being used for the two 4,000 light alternators. This dynamo board is built of iron and marble, no combustible matter whatever entering into its construction. All of the connections are behind the board. On this same gallery

ELECTRIC FOUNTAIN.

are arranged the large rheostats for the field circuits of the generators. The panels on this gallery are connected with the dynamos by means of lead covered cables supported on the floor in special iron brackets, and led down the wall behind the paneled sheathing, from which point they are distributed to the different machines underneath the flood of machinery hall, by the use of lead covered cables supported in iron clamps. The lower gallery is reached by a single iron spiral railway, and the upper gallery which is fourteen feet in width and eighty-three feet in length, is reached by two narrow stairs, one at each end of the dynamo board. On this upper gallery is located the feeder board, which is also built of iron and white marble. This feeder board consists of a panel for each of the forty feeders leaving the station for the different parts of the ground. Nothing appears on the face of it but the indicating instruments, and the handles of the switches, with the various plugs and cords required in making changes from one dynamo to another. As in the case of the dynamo board, all wiring is back of the panels and everything is made as nearly fireproof as possible. Behind this board are located the transformers for the Stillwell regulators, one of which is inserted in each of the forty feeders leaving the station. These regulators provide for a variation of ten per cent. in the feeders, the losses in the



GENERAL ELECTRIC ARC PLANT, ELECTRICITY BUILDING.

feeders themselves ranging from 2 per cent. to 10 per cent. under full load. All of the instruments used on both switch-boards are of the frameless plate glass case type. Each panel is made a duplicate of all other like parts in the board, everything being interchangeable. The trimmings on both boards are nickel-plated metal and hard rubber. The feeder board is so arranged that any one of the forty circuits can be operated from any one of the dynamos of the plant. It is also so designed that in case of one of the dynamos becoming disabled, the feeders of this particular machine can be changed to a relay dynamo, always kept in operation, by simply pulling the switches. It is impossible to fully describe the switchboard or any part of the installation in a short article, as the exhibit must be visited to fully appreciate the character of the work.

Besides the incandescent lighting plant just described, the Westinghouse company furnishes all the power for driving machinery in the mines and mining building. For this purpose two 150 horse power 500 volt continuous current motors of the multipolar type are installed in the mines building and connected to the shafting driving exhibit machinery. These are operated from the large power generator in machinery hall.

In electricity building a very creditable exhibit is to be made, some of the special features being a long distance power transmission plant, in which is shown a two-phase generator driven by a Pelton water wheel, the current from this generator to be led to "step up" transformers and then to "step down" transformers. In another space are multiphase motors, revolving transformers, incandescent lights, arc lights, street railway motors and other devices, all operated from the alternating current generator in the space across the aisle. In this exhibit is also shown a 500 horse power two-phase alternating current motor. A complete exhibit is made of incandescent and arc lighting apparatus of the ordinary types of Westinghouse manufacture, and also of the various details manufactured. In another block of space in this building may be seen the railway exhibit of the Westinghouse company, which comprises large belt driven railway generators, and one of the direct connected 270 horse power "kodak" generators. The space occupied by Westinghouse exhibits in electricity building is something over 15,000 square feet.

The Work of Last Week.

Through the discouraging weather of the early part of last week and the brighter days of the closing portion, the work at Jackson Park was pushed with feverish activity. Officers and employes of the construction department, chiefs of departments and their subordinates, exhibitors and concessionaires all labored at high pressure. From ten to twelve thousand men were employed on the grounds, and in many portions work was pushed day and night. The sound of hammer and saw was heard on every side; messengers were running in all directions; great gangs of men were at work on the roads and landscape features; trucks and delivery wagons heavily loaded with exhibits and service supplies succeeded one another so closely as to form a score of winding processions; long lines of freight cars, loaded and empty, followed puffing locomotives on all the railroad tracks leading to the great buildings; creaking cranes and derricks dotted many of the buildings in which machinery was being installed, and in all show-cases and booths were being erected or placed in position; painters and decorators were at work in every corner; and the whole scene was one of the greatest animation and activity, enlivened by hoarse cries of command or expostulation in half a dozen languages and diversified by the queer costume of Turk or Egyptian. Many workmen put in sixteen hours out of twenty-four and made $6 or $7 a day.

In all this "hustle" and bustle the electrical preparations did not lag. Chief Barrett spent most of the week in the electricity building, sleeping there nearly every night. He was ably seconded by his assistants, Messrs. Hornsby and Hawley, who were untiring in their efforts to get things in shape. On Wednesday night a fifty-light circuit of arc lamps was operated for the first time, and night work became general. Everybody was working with a vim, and, while the display in the building was not complete at the close of the week the indications were that it would be entirely finished in ten days or two weeks.

No force of men connected with the World's Fair put in harder or more effective work last week than the "boys" of the mechanical and electrical engineering departments. They worked night and day, and during the latter part of the week R. H. Pierce, the electrical engineer, and Mr. Neiler, assistant electrical engineer, never left the grounds. Demands for arc lights came from every quarter, as the need of night work was pressing, and the energies of the department were mainly devoted to meeting these requests. Four coronas, with about 250 arc lamps, were burned under the giant trusses of the manufactures building nearly every night of the week, and light for the installation of exhibits was also furnished to the other principal buildings. On Friday night arc dynamos with a capacity for 2,500 lights were ready for operation in machinery hall. Much work was also accomplished in the way of placing decorative lights about the basin, in front of the administration building, which was the center of attraction at the opening on Monday. All the power, police and fire alarm wires were taken down from the temporary pole lines, the permanent wiring for these branches of the service being entirely completed. An automatic device for the electrical operation of the valve admitting steam into the cylinders of the Allis 2,000 horse power engine was devised, and the electrical connection setting the engine in motion was arranged to be made by a switch at the stand in front of the administration building, to be turned by President Cleveland. This mere outline gives but a faint idea of the immense amount of electrical work accomplished during this exciting week, but it is safe to say that the remembrance of the stress and turmoil of it will ever remain a vivid recollection in the minds of the chief participants.

On Thursday the big Allis engine in machinery hall was turned over and it was also run without load on the succeeding day. It worked smoothly and well. The final touches were put on the beautiful Westinghouse switchboard and several of the big alternators. Manager Keller and Superintendent Reilly of the Westinghouse company have been forehanded in their work from the first, but they had plenty of work to do last week nevertheless.

There were many vexatious delays and annoying accidents. Preparations were made on Monday evening to pull down the iron stack of the old temporary electric power station and get it out of the way before many teams and people got on the grounds on Tuesday morning. A space was marked off toward the west in which it was proposed the stack should fall. In that direction there was a clear sweep and no danger. But the stack preferred to take another course. When the workmen engaged in the effort gave a pull on their ropes it tottered, swayed back and forth a moment, then with a crash fell across the electric wires and roadway to the north. As a result installation operations in the transportation building, telephones along the west side of the grounds and the fire alarm system were greatly interfered with. This gave rise to an international chorus of expletives. Thirty six temporary wires were broken, consequently everything from Sixty-second street to machinery hall and west of the lagoon was cut off from all communication with the service plant. The damage was repaired as quickly as thirty-five linemen could do the work.

On Thorsday a trial trip was made over the intramural road. A large number of invited guests assembled at the Fifty-seventh street station at 3:30 P. M., but owing to delays inseparable from the first trip from the car barns to a point so far north as Fifty-seventh street, it was nearly an hour later before the entire party was seated on the train which consisted of a motor car and three trailers. The approach of the train was also considerably delayed by the fact that some workmen had placed a hand car between the tracks in such a position that the wheels rested on the conducting rails, short-circuiting the system. The workmen were considerably startled at the display of fire that ensued, and the officers of the company experienced some annoyance. In the course of the ride several obstructions on the track were encountered in the shape of obtrusive guy-ropes and protruding platforms. These caused several delays, but it was demonstrated that only a few touches here and there were needed to put the entire system in running order. Among those on the train were B. E. Sunny, W. E. Baker, E. J. Spencer, B. J. Arnold, F. W. Horne, C. P. Matlack, C. H. Macloskie, G. K. Wheeler, J. Allan Hornsby, C. H. Wilmerding, Luther Stieringer and many others, including a large contingent of ladies. The chief engineer of the Alley "L" road of Chicago was an interested observer of the operation of the system.

An armature in the Thomson-Houston factories at Lynn, Mass., burst on April 9th. One piece struck F. C. Carter, a student, destroying the use of his right eye. His left arm was also broken, rendering amputation necessary.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

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VISITORS

To the World's Fair are requested to forward their addresses to the WESTERN ELECTRICIAN as early as possible or notify us immediately upon their arrival in Chicago.

During the preparatory stages of the World's Fair the WESTERN ELECTRICIAN presented complete reports of the progress of the work on the electricity building and other points of interest to the eletrical fraternity. Now that the exposition is opened this journal will present, from week to week, complete and accurate accounts of the happenings at the fair, furnishing a comprehensive record of the part that electricity plays in the great exhibition. The illustrations will, as heretofore, form a special feature. The WESTERN ELECTRICIAN has exceptional facilities for handling World's Fair news. It is the only weekly electrical paper in Chicago or the West, and will give special attention to the exposition and the electrical people in attendance.

ELECTRICITY and gas have come into competition again in Germany. This would not be strange if the work to be done consisted in the production of light, but instead the contract in view is for the operation of a street railway system. It seems that the inhabitants of the town of Erfurt are dissatisfied with the existing horse-car system, and the officers of the municipality have for some time been considering the request of the Thomson-Houston International company for a concession to erect an electric railway on the overhead trolley system. The municipality is disposed to entertain the proposal, especially as it is intended to extend the tramway system. On the other hand another company offers to operate the street railway service by means of cars driven by gas motors, which have already, it is said, given good results in Dresden, with the advantage of its not being necessary to use overhead wires. A decision has not been reached, but the city has appointed a commission to investigate the matter. Attempts have been made before to adapt gas motors to street railway work, but without conspicuous success. It is probable that the Dresden experiments have not excited much apprehension among the advocates of electric traction in Germany.

One of the most important features of the gathering of electrical people at the World's Fair this year will be the meetings of the electrical congress in connection with the exposition. This congress, it is anticipated, will be composed of representative scientists from every part of the world, and the work they have in hand will be of great interest and importance to the industry generally. Former gatherings of this description have awakened considerable interest, and some of them have been instrumental in bringing about advancements in the art, and the determination of points in controversy. None of them, however, has had the excellent opportunity which is presented the congress which will assemble in Chicago this year. An idea of the line of work which has engaged the attention of former congresses may be gained from Prof. Carhart's article presented in this issue, as well as the topics which it has been agreed to discuss at the Chicago meeting. Upon the question of programme Prof. Carhart says: "The committee having charge of this important congress has been alive to the interests involved and the responsibility of making the most of the opportunity in the interest both of the science and the applications of electricity. The occasion is a fitting one on which to settle in an official way the matter of electrical and magnetic units and nomenclature for years to come. With this in view provision has been made for an official section or legislative council, the members of which shall be appointed by the governments which they represent. To this council shall be submitted all questions bearing upon the adoption of units and terms. After the legislative council has passed upon the questions coming before it, the units adopted will only need ratification by the several governments represented to become truly and legally international." The official character of the congress, together with the standing of the men who will compose the body, will lend great weight to its decisions. The fact that the meetings will be held under the sanction of the governments represented will greatly influence the public in accepting its decisions. Marked contrast is shown between the congress of 1881 at Paris; that, held three years later in Philadelphia, and those of more recent years, with which we are all familiar. These proceedings, while interesting, instructive and valuable, did not attract the wide attention or receive the same consideration as those of the original congress at Paris. It is believed that the Chicago congress, by reason of its official character and the eminence of the men who will participate in its deliberations, will even out-shine the Paris assemblage of 1881. This is to be hoped, at least. The gentlemen in charge of the arrangements have availed themselves of the experience and advice of the leading electrical scientists of this country and Europe.

By the time that this issue of the WESTERN ELECTRICIAN reaches its readers the news of the opening of the great World's Columbian Exposition will be familiar to two hemispheres. In the opening ceremonies, as in the work of construction and the completed exhibition, electricity played a prominent part, for it was by the completion of an electric circuit, by means of a switch turned by President Cleveland in the stand erected for the exercises, that the largest engine in the service plant was started, signalizing the formal opening of the exposition. At the Centennial President Grant turned by hand a valve supposed to admit steam into the cylinders of the Corliss engine, although it is now asserted that the wheel thus actuated was a dummy and that the real valve was manipulated by a workman concealed from view. In 1893, however, the aid of electricity is invoked for a similar purpose. The change is indicative of the spirit of the age, and it is also significant that the engine set in motion by the president on Monday will drive electric lighting machinery, with a maximum capacity of 20,000 16 candle power lamps—an achievement undreamed of in 1876.

It needs but a glance through the pages of the richly illustrated issue of this journal now before the reader to assure him that in many respects the World's Fair is simply a great electrical exhibition. Not only is a separate building devoted to electrical exhibits for the first time in the history of international expositions, but it is a fact that only a small portion of the current used on the grounds will be employed in this building. Every portion of the grounds will be supplied with circuits for electric light and power. There are direct and alternating current arc lamps and lights of this description run on ordinary incandescent circuits and on 500 volt power circuits. In incandescent lighting the systems are no less varied—alternating, direct current, two-wire, three-wire and five-wire. Power transmission is accomplished by continuous, ordinary alternating and multiphase currents on circuits of 110, 220 and 500 volts. Electric traction is shown on an elevated structure, where trains capable of carrying 400 passengers are operated by motors of over 500 horse power capacity. Secondary batteries are pressed into service to operate a large fleet of electric boats, with a charging station reputed to be the largest in the world. The greatest search-light in the world is mounted on one of the buildings, amid a number of other large projectors. The electric fountains will be very beautiful and impressive, and will undoubtedly excite as much popular attention as any other single feature of the exposition. Decorative lighting will be lavishly used, not only in the electricity building, but all about the grand basin, which is perhaps the central point of interest. Electric elevators will be in service, cooking will be done by electricity, and experiments will be made on the effect of electric light on plants deprived of sunlight. Nearly every kind of dynamo and motor in use will be shown attached to the moving power by about every method known to mechanical engineering. In short, every application of electricity known in the arts will be presented. All these features are briefly described in this number, which is believed to be the most complete exposition of electricity at the World's Fair ever attempted.

All this has not been accomplished without great energy and effort, and there have been disagreements and heart-burnings in the electrical as well as all other departments of the great work that has engrossed so much of Chicago's attention for the last three years. These are due to the infirmities of human nature, and were to be expected in an enterprise of the magnitude of the World's Fair. But now that the exposition is fairly open and the perplexing questions that have arisen during the work of construction are nearly all things of the past, we may expect that all interested in the exposition will devote themselves heartily to the reception of Chicago's guests, forgetting old animosities.

The thanks of the electrical fraternity are due to the officers of the exposition, both national and local, for the enlightened and progressive spirit they have displayed in making the World's Fair a reflex of this electrical age. To such men as George R. Davis, D. H. Burnham, H. B. Stone, Col. R. C. Clowry, John P. Barrett, Frederick Sargent and R. H. Pierce the success of the electrical side of the exposition is due, and this is a fact worthy of general appreciation.

We only voice the sentiment of the electrical interests of Chicago and the World's Fair when we extend a most hearty welcome to all prospective visitors interested in this extremely interesting display. We assure them that they will have no occasion to regret a trip to the World's Columbian Exposition.

The World's Electrical Congress.

By Prof. H. S. Carhart.

The first international electrical congress ever held convened at Paris in connection with the International Exposition of Electricity of 1881. The success of this first convocation of electricians stimulated other later efforts to achieve a similar success. But the Conference of Electricians at Philadelphia in 1884, the Congress at Paris in connection with the General Exposition of 1889, and the Electrotechnical Congress at Frankfort in 1891 fell far short of making the impression on the electrical world produced by the first congress in 1881. This was not because they were not attended by electricians foreign to the country in which they were held, but because gade the steel were not official and the congress not strictly under governmental auspices. Another reason was that the progress made in theory and investigation since the decisions of the Congress of 1881, did not warrant any supplementary conclusions or any rectification of the units already adopted.

In 1881 the most distinguished electricians of Europe and America were in attendance at the congress by government appointment. Hence their conclusions were accepted as official, and carried weight both because of the distinguished reputation of the conferees, and because of their official relation to the congress. The Philadelphia Conference was a quasi-official one, but it accomplished little because it came too soon after the great assemblage of 1881. A part of the appropriation made by Congress, which was small, was expended in the determination of the ohm; and fortunately, for that work by Professor Rowland, has a permanent value.

For the system of electrical units employed for the last twelve years we are indebted to the first Paris Congress. In fact the name ampere as the unit of current was introduced at that time; and arrangements were set on foot for the determination of the ohm in terms of the length of a mercurial column at 0°C. and one square millimetre in cross-section. After eleven years the conclusion reached was formulated by the British Association committee on electrical units and standards at Edinburgh last August, with the concurrence of representatives from other countries, including Professor von Helmholtz. The length of the mercurial column is 106.3 Cm.

Before me lies a stout pamphlet entitled "Propositions on the Legal Definitions of Electrical Units." It was prepared by Dr. E. Dorn of Halle, gives an account of the Edinburgh meeting mentioned above, and reviews the work done on the determination of electrical units up to the present. This masterly brochure issues from the Curatorium of the Physikalisch-Technische Reichsanstalt in Berlin, under the signature of Dr. von Helmholtz, and is published by the order of the state secretary of the interior. It is sent out with the double object of conveying information and of eliciting any objections that may exist to the adoption of the practical units proposed. Germany is therefore already taking steps toward the official adoption of the conclusions reached at Edinburgh.

The stenographic report of the Frankfort Congress of 1891 fills two large volumes. The last one, bearing the date 1892, has just been received. A glance at the contents reveals the fact that many papers of permanent value were read and discussed. The officers of the congress have done the electrical profession a service by putting these papers in a form for preservation and reference. But the report indicates no important or authoritative steps taken toward the settlement of residual uncertainties in nomenclature and definition. Nor were additions made to electrical and magnetic terminology, which many deem important.

So much in relation to the results of past congresses. The World's Fair offers an opportunity for the gathering of electricians from all parts of the world. Every day brings information that distinguished members of the profession are coming from abroad. The committee having charge of this important congress has been alive to the interests involved and the responsibility of making the most of the opportunity in the interest both of the science and the applications of electricity. The occasion is a fitting one on which to settle in an official way the matter of electrical and magnetic units and nomenclature for years to come. With this in view provision has been made for an official section or legislative council, the members of which shall be appointed by the governments which they represent. To this council shall be submitted all questions bearing upon the adoption of units and terms. After the legislative council has passed upon the questions coming before it, the units adopted will only need ratification by the several governments represented to become truly and legally international. If this shall be accomplished and the Congress does nothing else, this will forever remain a sufficient *raisond'etre*.

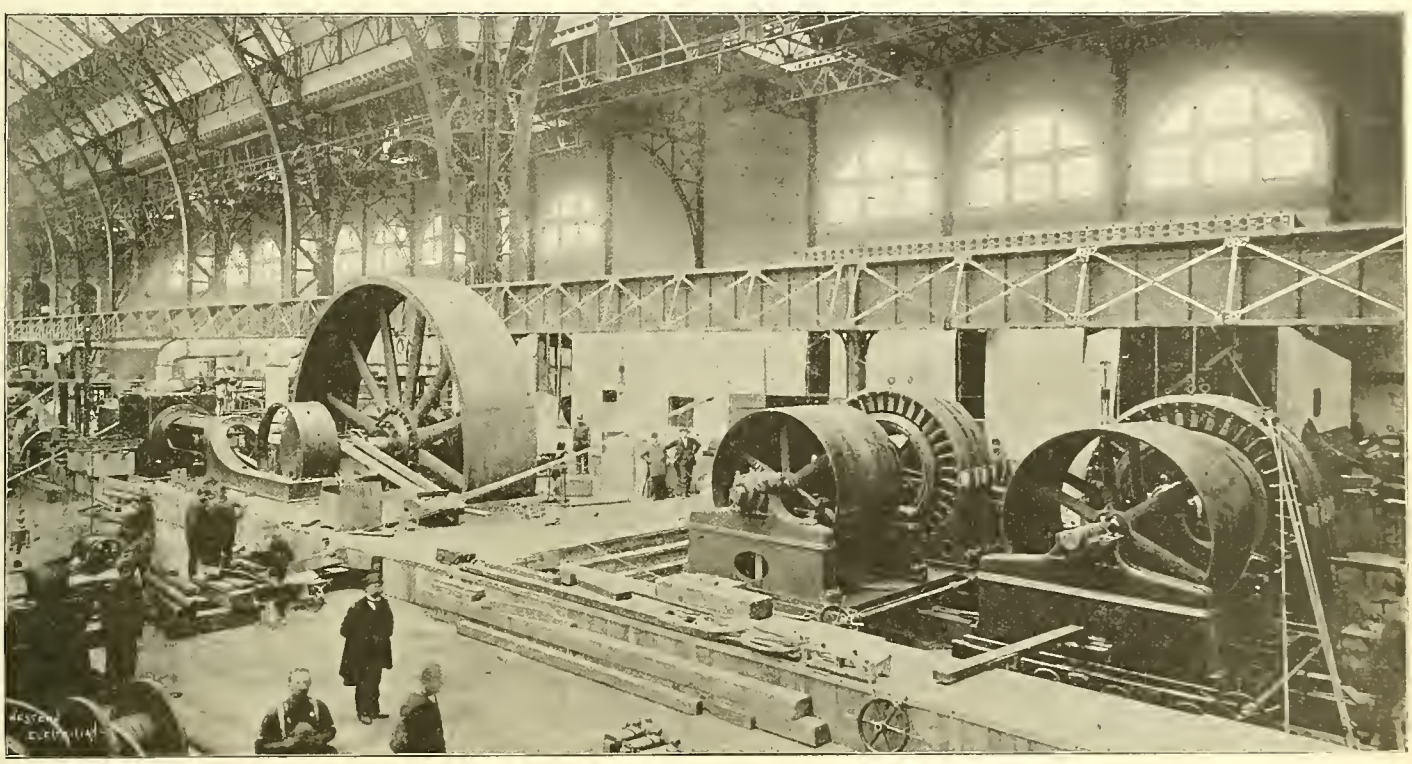
But much more than this is proposed. The committee on programme and papers is presided over by Professor Mendenhall, director of the United States Coast and Geodetic Survey, and numbers among its members Professor Rowland and the sub-committee of the American Institute of Electrical Engineers. This committee has been for some time at work, and will hold a meeting in Washington, at which time the business will doubtless be greatly forwarded. The joint committee of the British Royal Commission and of the London Institution of Electrical Engineers has already done good service and is still ready to aid. Its co-operation will contribute greatly to the success of the congress. To it can be committed the task of securing appropriate papers from English electricians.

Another important feature of the congress will be its public illustrated lectures. Two or three of these will probably be given. The most recent and most striking experiments will probably be shown on a scale worthy of the occasion. This feature will render the congress an occasion long to be remembered, as affording an opportunity for visitors from many countries to witness the latest successes and most impressive phenomena that the science can present.

Only twelve years have elapsed since the Paris International Exposition of Electricity. Then electric lighting was in its infancy and was probably witnessed for the first time by many thousands. The World's Fair will exhibit electric lighting on a scale never before attempted or proposed. It may not exhibit novelties but it will certainly be impressive by its magnitude. In 1881 the electric railway, built by Siemens & Halske to run a few hundred feet from the exhibition building, was one of the most interesting novelties. It is not necessary to say that electric railways are no novelty now.

The electrical congress of 1881 placed applied electricity on a scientific basis, supplied it with units of measurement, and produced a stimulus to the invention of instruments of precision that is still felt all over the world. Sir William Thomson went home from it and brought out his "graded galvonometers," the first of a long line of the most valuable standard instruments. He also published not long afterward his theoretical investigation of the best relation between the resistances of a shunt dynamo; and Clausius, who was also a member of the congress, followed with his exhaustive theoretical paper on the dynamo machine. It was to be sure a period of great activity in electrical discovery and invention; but the congress has had no inconsiderable share in directing this activity and furnishing it with the means of quantitative expression.

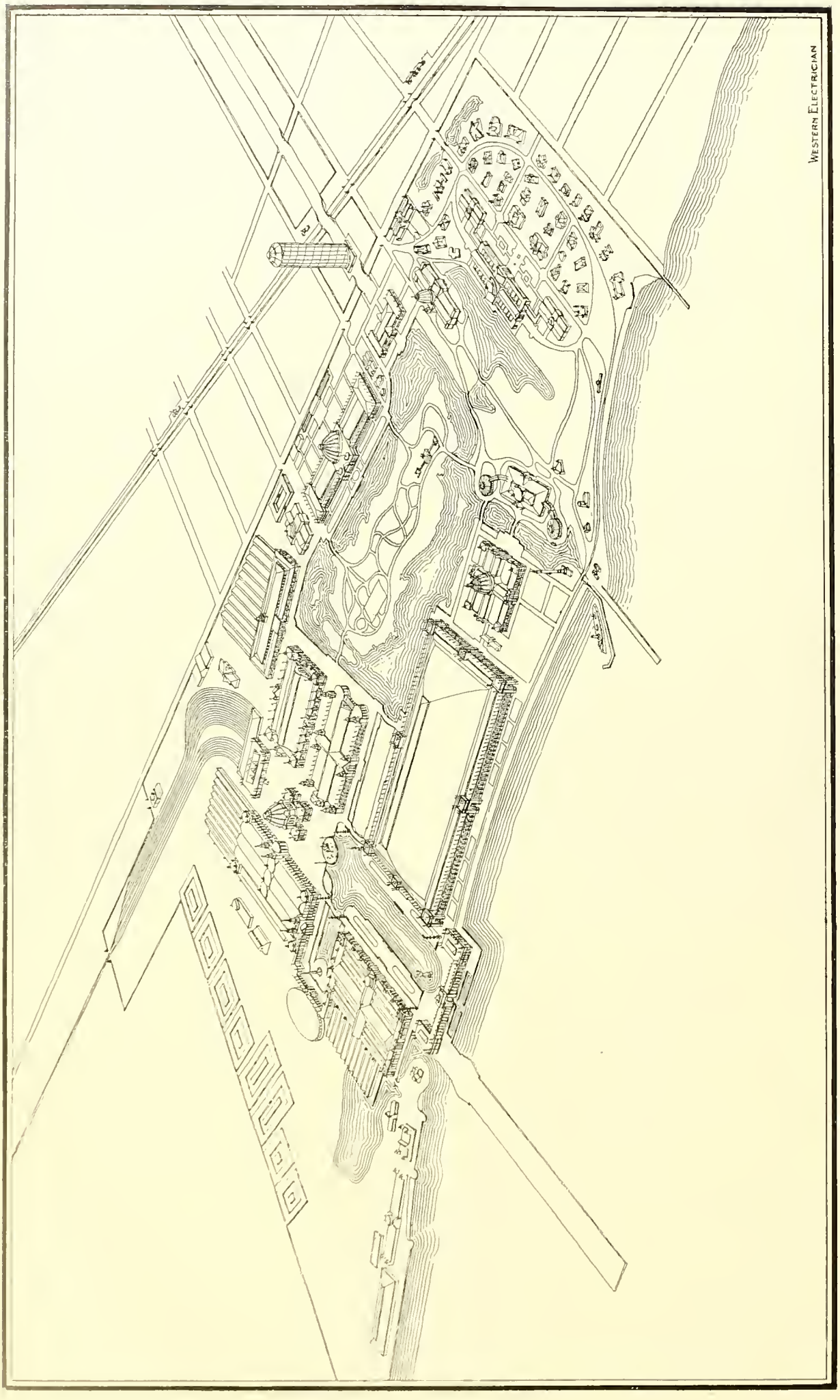
It is not at all improbable that the influence of the World's Fair on electrical activity will be no less forceful than at Paris; and the congress of electricians, let us hope, will make this an occasion of signal usefulness and of international electrical unification.

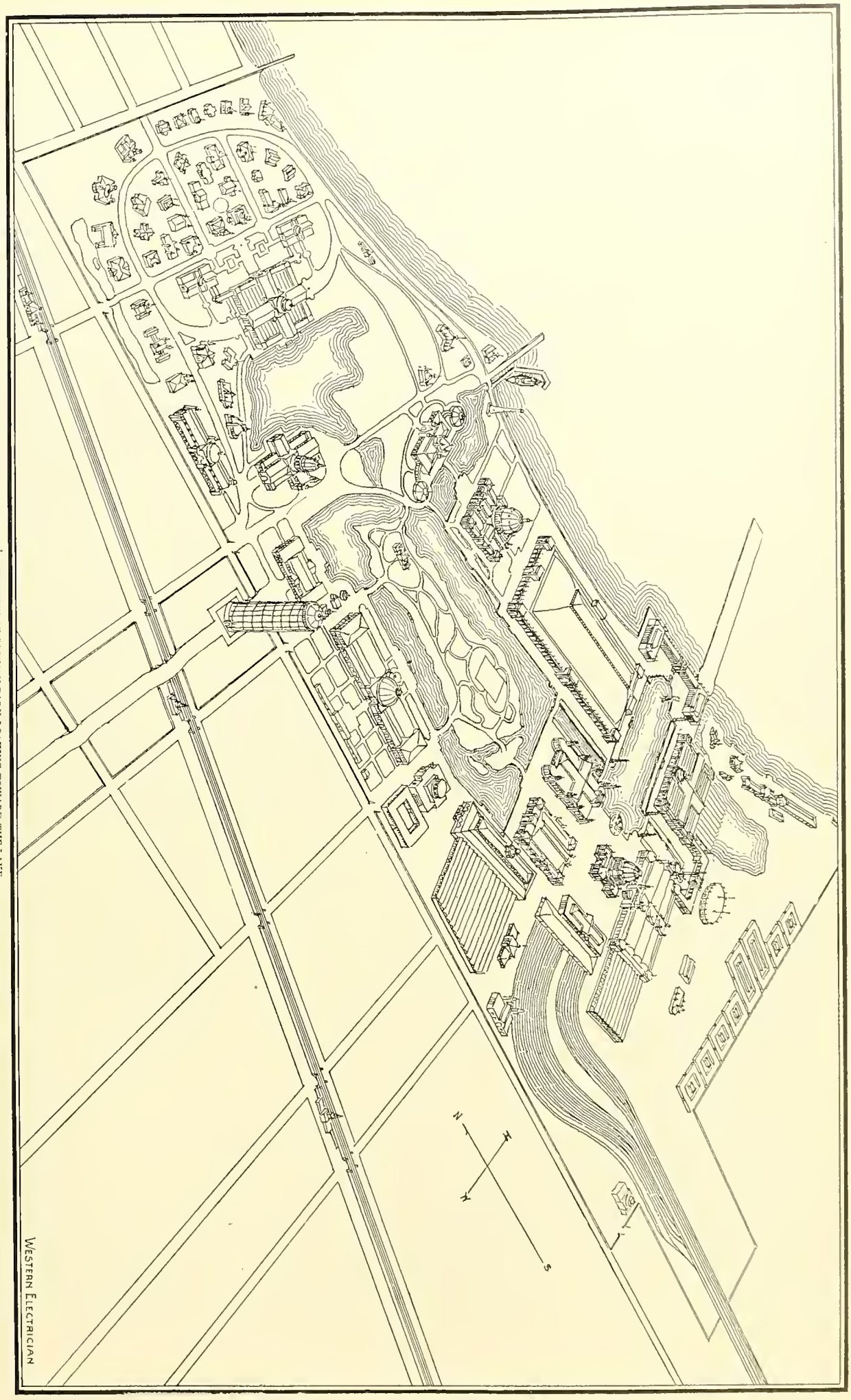


ALLIS 2,000 HORSE POWER ENGINE DRIVING TWO WESTINGHOUSE 10,000 LIGHT ALTERNATORS, MACHINERY HALL.

The city council of Lonaconing, Md., has granted a franchise to the Lonaconing Cumberland Railroad & Power company, which will build an electric railway from the city of Cumberland, via. Lancaster to Westernport.

The Rutland Electric Light company, Rutland, Vt., after long continued litigation with the Marble City company, has at last secured a perpetual injunction restraining the Marble City company from so erecting its poles or stringing wires as to interfere in any manner with its poles. This decree was confirmed with order for removal of all conflicting wires and poles of the Marble City Electric Light company by the Supreme Court of Vermont, Judge Tyler, presiding. The decree of the court also provides that a commission shall be appointed to determine the amount of damage sustained by the Rutland company by the Marble City company's infringement on its rights and property.


WESTERN ELECTRICIAN
BIRD'S EYE VIEW OF JACKSON PARK LOOKING FROM THE LAKE.
Horticultural.
Woman's.
Art Gallery.
State Buildings.
Terminal Station.
Mines and Mining.
Transportation.
Administration.
Electricity.
Wooded Island.
Manufactures and Liberal Arts.
U. S Government.
Fisheries.
Forestry.
Leather.
Agricultural.
Mechanery Hall.
Krupp Gun.
Casino.
Pier.
Music Hall.



BIRD'S EYE VIEW OF JACKSON PARK LOOKING TOWARD THE LAKE.

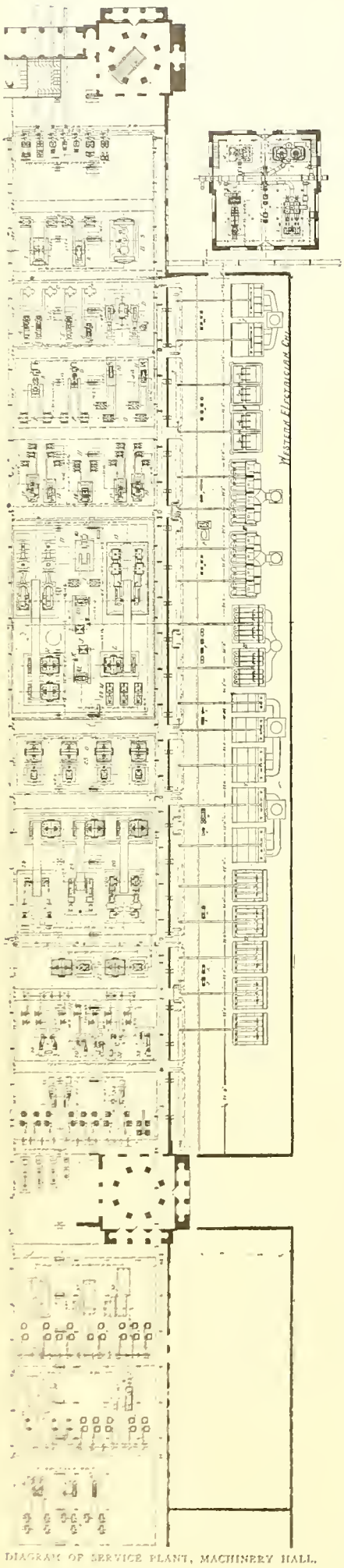


DIAGRAM OF SERVICE PLANT, MACHINERY HALL.

Telephone and Telegraph Service.

Modern telephone and telegraph service showing the best construction attainable to-day in both these important departments will be a most important feature of the arrangements for the fair. The equipment specially prepared for the exposition business is described in the appended articles:

World's Fair Telephone Exchange.

BY A. S. HIBBARD.

In the west corridor of the American Bell Telephone company's booth, at the south end of electricity building, the World's Fair telephone exchange is operated by the Chicago Telephone company.

The main distributing board, from which all the cable wires are directly led, is placed at the south end, and is directly over a large man-hole, eight by eleven feet, into which the underground conduits and cables are led. The top of this man-hole is covered by an iron grating, and the man-hole itself is so illuminated that its interior may be plainly seen, and the cable heads, conduits, bridle wires, etc., are in plain view.

From the main distributing board the wiring leads to the intermediate distributing board, next to which comes the operating switch-board itself. This consists of five and one third sections of a three-wire branch terminal multiple board, manufactured by the Western Electric company. One and one-third sections are utilized for incoming trunk wires, which will be operated on the single wire plan, with visual signals provided for the disconnection order. The four additional sections, with positions for three operators each, provide for 800 lines which may be operated in the World's Fair exchange. Visual signals are arranged governing all outgoing trunk wires. The annunciator drops are of the self restoring pattern, and the latest mechanisms employed in switching appliances for telephone exchanges are here found in operation.

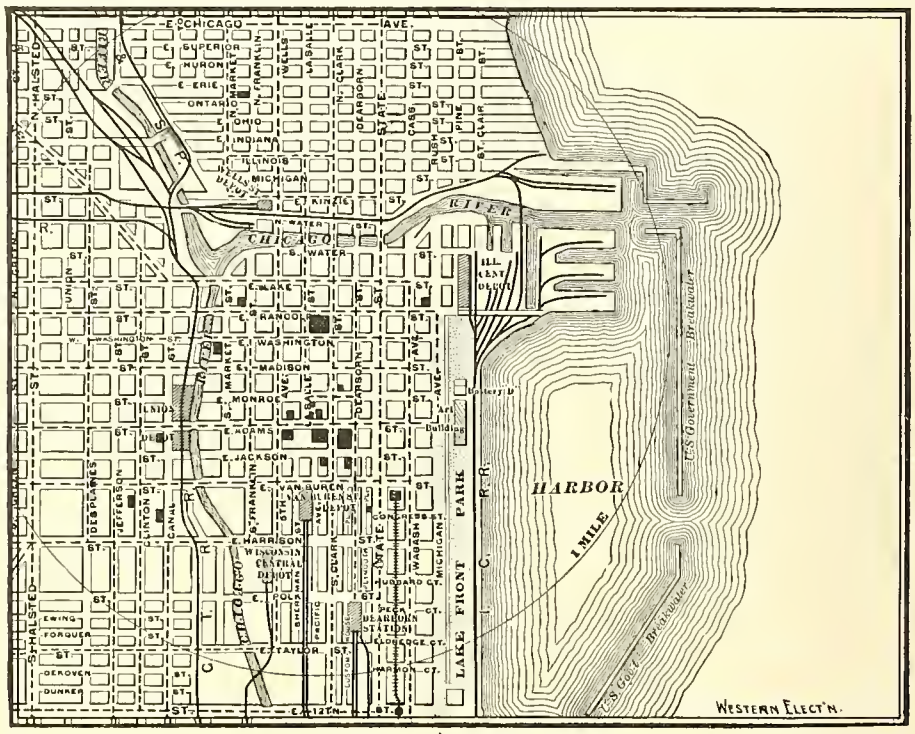
All telephones operated in connection with the exchange are of the long-distance pattern and are connected by copper metallic circuits. All of the trunk wires are also metallic circuits, there being fifty outgoing and fifty incoming trunk wires operated in connection with the exchange.

A call may be made from a subscriber's instrument at the World's Fair to a subscriber in the main Chicago exchange on Washington street, as quickly as from one main office subscriber to another, and the transmission has been found to be just as perfect as over shorter exchange lines.

The long-distance lines are led directly to one of the switching sections, by means of which conversation may be had with New York, Boston, Pittsburg, Buffalo, Detroit, Milwaukee and other points reached directly by the long distance lines.

At twenty-five points in the various buildings throughout the grounds public telephone stations and American District Telegraph messenger offices have been established by the Chicago Telephone company. At these offices sound-proof booths have been provided, making it possible to carry on conversations with the the utmost privacy. Persons within the various buildings who may not have telephones may be called by messenger to any one of these public stations, and the wants of the general public, both for telephone and for messenger service, will thus be provided for.

In establishing this telephone exchange upon the most modern and best metallic circuit basis, the Chicago Telephone company is showing what may now be accomplished in any exchange similarly equipped.



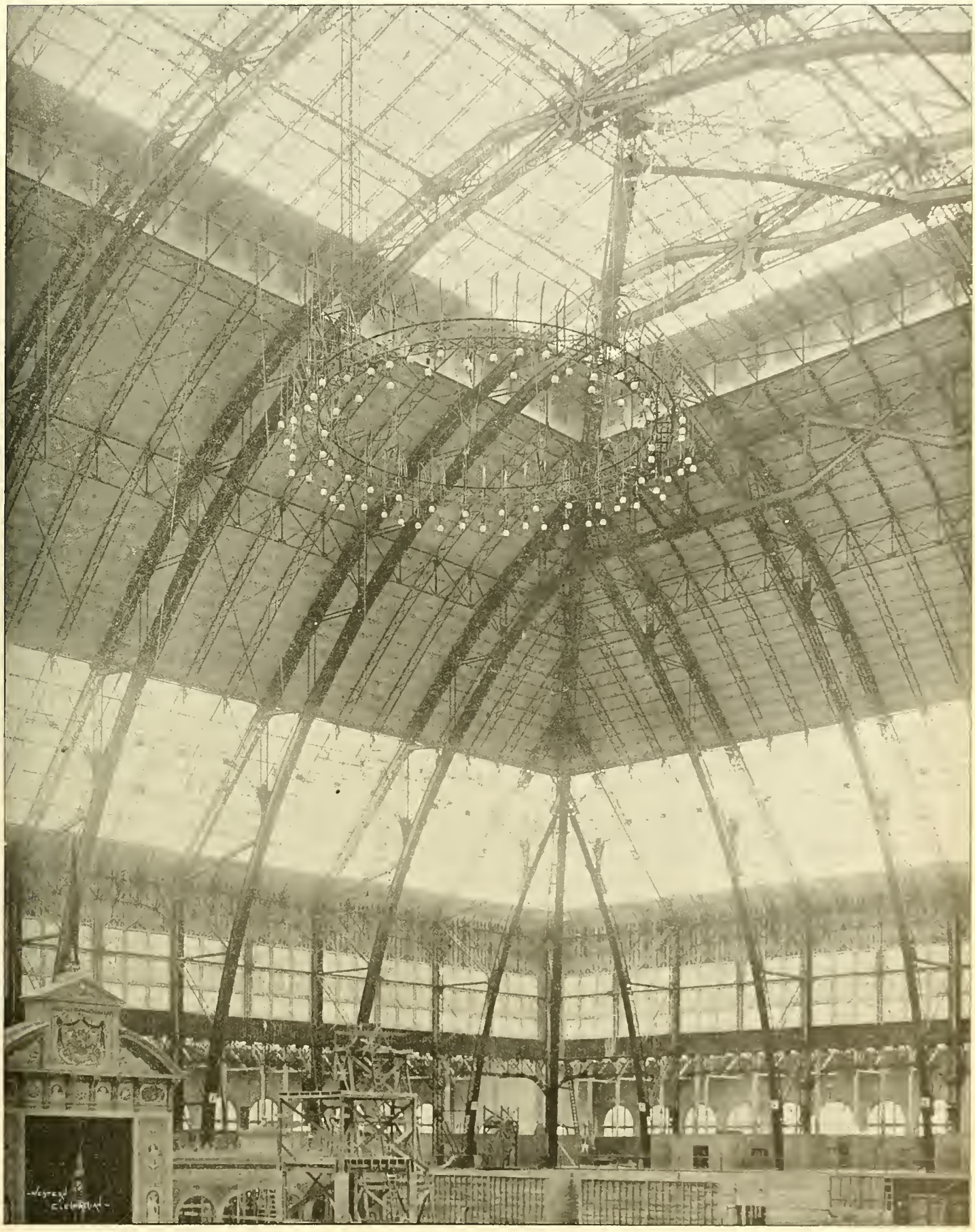
MAP OF CHICAGO'S BUSINESS CENTER.

Chicago Electric club, Clark and Monroe streets.
Post Office, Clark, Adams and Dearborn streets.
Postal Telegraph company, Clark and Jackson streets.
Western Union Telegraph company, Clark and Jackson streets.
WESTERN ELECTRICIAN, Clark and Adams streets.
Western Electric company, South Clinton near Van Buren street
Chicago Telephone company, Washington and Franklin streets.
City Electrical Department, City Hall, Randolph street.
Chicago Edison company, Adams street.
American Battery company, 177 La Salle.
E. Baggott, 171 East Adams street.
Central Electric company, 118 Franklin.
Chicago Rawhide Manufacturing company, 75 Ohio.
Cushing & Morse, 225 Dearborn.
George Cutter, Rookery.
Standard Underground Cable company, Rookery
Clark & Marshall, Rookery.
Stearns Manufacturing company, Rookery.
Hill Clutch Works, Rookery.
Strowger Automatic Telephone company, Rookery.
Electric Appliance company, 242 Madison.
Ansonia Electric company, 104 Michigan avenue.
Enterprise Electric company, 315 Dearborn.
General Electric company, 175 Adams.
Great Western Manufacturing company, 195 South Canal
Charles E. Gregory, 347 South Jefferson.
Wm. Hood & Co., 239 La Salle.
H. W. Johns Manufacturing company, 242 Randolph.
Knapp Electrical Works, 56 Franklin.
J. A. Roebling's Sons company, 173 Lake.
Siemens & Halske, Monadnock.
Sargent & Lundy, Monadnock.
Harrison & Cary, Monadnock.
Bryant Electric company, Monadnock.
Watertown Steam Engine company, Monadnock.
Detroit Electrical Works, Monadnock.
Kohler Bros. (Eddy Electric Manufacturing company), Monadnock.
L. K. Comstock, Monadnock.
Thos. G. Grier, Monadnock.
W. B. Pearson & Co., 401 Home Insurance Building.
Standard Electric company, 317 South Canal street.
Railway Equipment company, Pullman Building.
Sterling Boiler company, Pullman building.
Star Electric Lamp company, 805 Chamber of Commerce.
Chicago Incandescent Lamp company, 75 North Clinton street.
Charles Munson Belting company, 36 South Canal.
Patton Motor Manufacturing company, 45 Lakeside.
J. K. Pumpelley, Springer building.
Fraser & Chalmers, Lake and Fulton streets.
McGuire Manufacturing company, 122 N. Sangamon.
Matber Electric company, 161 Randolph.
New York Safety Steam Power company, 64 South Canal street.
Westinghouse Electric & Manufacturing company, Pullman Bldg.
Carroll & Furlong (Chicago Insulated Wire company), 214 Northern building.
Illinois Electric Lamp company, South Canal street.
Washburn & Moen Manufacturing company, 107 East Lake.
New York Insulated Wire company, 80 Franklin street.
Chicago & St. Louis Electric Railway, 915 The Temple.
Culler & Hammer, 313 South Canal.
Taylor, Goodhue & Ames, 348 Dearborn.

Western Union Telegraph Service.

BY WILLIAM J. LLOYD.

Whether it be a national convention, a national election, the inauguration of a president, a Johnstown flood, a Homestead riot, or a New Orleans prize fight, the service of the Western Union Telegraph company has always been foremost in its adequacy and its promptness. In its mag-



SEVENTY EIGHT LIGHT ARC CORONA, MANUFACTURES BUILDING.

nitude and scope it will in our time at least stand without an equal, and yet how few in busy America stop to think of the advantages or the vastness of such a system. It is safe to say that the Western Union in its preparations for the World's Fair is making an effort beyond anything yet attempted by that company, but only wire company men will comprehend the great work of preparing for the fair, and, simultaneously with the opening date, the removal of its Chicago office. It is the second largest in the country and its ramifications probably the most complex in the world, considering the great number of trunk line railroads centering at Chicago, its grain and stock exchanges, its leased wire offices, its newspapers, press associations, branch offices, time service and all the varied interests centering in Chicago main office.

The visitor to the great exposition will find the main office of the company in the southeast wing of the administration building fully equipped with direct wires to all leading cities of this country, dynamo currents, quadruplex, duplex and single wire machinery manned with the best grade of operators and receiving clerks capable of speaking the popular tongues of Europe. In addition to this there will be branch offices in the manufactures, machinery, agricultural, casino, terminal, transportation, service, mines, electricity and fisheries buildiogs, together with other branch offices in the California, Washington and New York state buildings. In the Midway Plaisance there is to be an office at the Ferris wheel and one in the German cafe, with possibly others not yet located.

To meet the requirements of the press and public, the Western Union company has strung a 19 conductor aerial cable from its Twelfth street underground terminal to the exposition grounds, and, if necessary, each conductor can be quadruplexed, making a total of 76 circuits—a greater number than was available at the recent national convention held at Minneapolis, where a single day's transmission reached the great number of 470,000 words, and this, by the way, was in excess of any one day's filing at any of the national conventions held so far in this country.

From the main office on the exposition grounds leading to all of the buildings mentioned there is a complete underground system carrying cables necessary for the branch offices and for the time service, which will be made a special feature by the telegraph company in connection with the Self-winding Clock company. Arrangements have also been completed for daily connection with the National Observatory clock at Washington so that the dropping of the ball at high noon, so familiar to our New York friends, will greet them from the great dome of the government building on the exposition grounds, the same circuit being utilized daily to synchronize all clocks located in the different buildings throughout the grounds.

In the electricity building the company has established a magnificent booth for the display of an interesting collection of historical devices and other apparatus of special value, including the original apparatus used by Prof. Morse and a photographic copy of the first message that was sent by him; a bust and portrait of Prof. Morse and his mementos and diplomas that were bestowed upon him by various cities and countries; one of the most modern quotation instruments; a Western Union telegraph office in operation, from which messages may be sent to all parts of the world; statistical tables showing the growth of the Western Union Telegraph company and its relation to the wealth, population, railroad mileage, etc., of the country. These exhibits will refer to the land line system.

Then to represent the cable service of the company and its connections in Europe, South America and the far east, there will be a bust and portrait of Cyrus W. Field and various interesting mementos of him in connection with the first Atlantic cables; a model of the Great Eastern, which was the first steamship employed in laying the Atlantic cable; a model of the repairing ship of the Central & South American Telegraph company, which is the latest repairing ship that has been built; a model of the original grapnel that was used in the first Atlantic expedition; models of the most recent grapnels for deep sea work; samples of the submarine cables of the Western Union Telegraph company and of the materials of which they are composed, photograph of the Great Eastern; model of the bed of the Atlantic ocean; map of the world; model of the steamship Mirror. In design and equipment this booth will probably prove one of the most attractive of the electricity building.

In addition to the 115 branch offices which the Western Union had already established previous to the exposition, it has established 65 new ones, making a total of 250 branch offices in the city of Chicago to be operated during the period of the fair, so that the stranger visiting Chicago during the coming half year may be in constant communication with business interests, home and friends.

An especial effort will be made on the part of the company to give the most prompt service between all principal hotels in the city, so that telegrams between friends making appointments, meeting places, etc., will be transmitted without delay.

Postal Telegraph-Cable Company.

BY E. J. NALLY.

The Postal Telegraph-Cable company has arranged for a main office on the ground floor of the administration building, which will be equipped for a modern telegraph office. The tables are especially made for the office, and are constructed so as to provide accommodations for typewriters, with which each table will be equipped after an improved plan. All business will be received by expert typewriter operators, as this company makes the use of the typewriter a feature of its service. Direct connection will be had with all the principals cities from the main World's Fair office, including a special wire to the cable office. Branch offices will be found in the agricultural, electricity, mining, machinery, casino, service, manufacturers and liberal arts, and in several state buildings, making fifteen to eighteen offices in all. There will be two offices in the manufacturers and liberal arts building, one at the south and another at the north end. The company has also arranged for exclusive privileges for branch office purposes, in more than twenty-five of the hotels, located outside of the exposition grounds, but in the immediate vicinity. Employment will be given to seventy-five people within the grounds proper, and the same number in the various hotels, in the vicinity of the grounds.

The Commercial Cable company which is the ocean connection of the Postal, has arranged for an interesting exhibit at its headquarters in the electricity building where a pavilion has been erected. This display will present in miniature a complete model of the Mackay-Bennett system. The sides of the pavilion will be fitted up to represent the terminal stations of the company at Dover Bay, Nova Scotia, and Waterville, Ireland. The apparatus used will be duplicates of the instruments employed in these stations, and will consist of siphon recorders by which the signals are received and improved automatic transmitters by which the messages are sent. Dover Bay and Waterville are in reality about twenty-seven hundred miles apart. In the working model they are separated by twenty-seven feet. They are connected, however, by a duplex artificial cable, electrically identical with the deep sea cables employed by the Commercial Cable company. Visitors will have an opportunity of witnessing the method of transmitting and receiving cable messages at this booth. There will be an interesting display of all kinds of cable in different conditions. The method of locating faults at sea, the laying and repairing of cables and other practical features of everyday cable work will be shown. A seven foot model of the "Mackay-Bennett" the latest repair ship of the Commercial company will be on exhibition. The pavilion in which this display is made forms one of the most artistic structures at the exposition.

Columbian Intramural Electric Railway.

BY C. H. MACLOSKIE.

Provision is made for the transportation of visitors about the grounds of the Exposition, affording an excellent view of the buildings and the ornamental features of the grounds, by the establishment of an elevated electric railway system. The Columbian intramural railway skirts the whole of Jackson Park, giving ready access to all of the prominent buildings of the fair. Starting at the south loop, close to the reproduction of La Rabida, it passes south by the side of the Krupp gun and the leather exhibits, the forestry building, turning west and north near the power station and carhouse of the railway. Thence through the midst of the exhibits of windmills to the colonnade, swinging around the west end of machinery hall, it turns north, passing in succession the railroad terminal station, the transportation, horticultural and woman's buildings and reaching that part of the grounds allotted to the state buildings. Proceeding still farther north it passes through the Esquimaux village, whence it turns east and south near the art galleries, and ends at the north loop close to the fisheries, United States government and manufacturers' buildings.

There are in all ten stations, each train making eighteen stops in a round trip. The stations are arranged with special reference to the safe and rapid handling of the large crowds which will be encountered. The stairways are wide and easy to climb and the stations themselves are brilliantly lighted with incandescent lamps. The ticket offices are placed so that in most cases one ticket office will answer for passengers going in either direction.

The length of the road is about 6¼ miles of single track, and counting stops at stations, the time taken for the round trip is about 45 minutes. Fifteen trains running continuously give a headway of three minutes. The average speed during the round trip is low, but at certain points a speed of 30 miles per hour is attained. The short distances between stations and the large number of curves prohibit high speed, except in a few instances.

Each train consists of four open cars with a total seating capacity of 400 passengers. The cars are 50 feet bodies, built with cross facing seats, each compartment being closed in on either side by a pair of sliding doors operated from the end of the car.

Fourteen incandescent lamps evenly distributed along the sides of each car furnish an abundant supply of light, and give the car a cheerful appearance at night. The cars are built by the Jackson & Sharp company of Wilmington, Del., and are mounted on trucks manufactured by the same company after the pattern of the trucks now in general use on the Chicago and New York elevated roads, with a few improvements in design which have been suggested by experience on the roads mentioned. The wheels were furnished by the Griffin Wheel & Foundry company of Chicago. A new style of wheel is here introduced to elevated service. This wheel is a cast iron spoke wheel, 36 inches in diameter with M. C. B. tread, flange and wheel fit, the spokes set spirally so as to relieve the shrinkage strains.

The brakes were furnished by the New York Air Brake company, and are of the type known as the "straight air." This form was chosen on account of its advantage over the automatic, in the ease of making smooth and accurate stops. This advantage was thought to more than offset the special feature of the automatic air brake since the probabilities of four car trains breaking in two are slight.

The Jewett Supply company's roller bearing device has been placed between the body bolster and the truck bolster, so that the cars creep around the curves with much less friction and consequently with less noise than the ordinary form of side and center bearings.

The first car of a train is equipped with four motors, capable of developing 133 horse power each, at a speed of 25 miles per hour. These motors, specially built for this equipment, are of the four-pole type, with toothed armatures, connected to the axle through a single set of gears.

The speed of the motors is controlled on the series-parallel principle, the motors being all in series at the start, in series-parallel for intermediate, and in parallel for full speed. The changes are made gradually so that no sudden jumps are felt as the speed is increased. As the current required is large, the controlling apparatus must be correspondingly heavy, and in consequence it has been found necessary to move the rotating cylinders of the controller by compressed air. Thus, to stop, start and regulate the speed of the train, a small lever is employed similar to the three-way valve of the air brake, enabling the motorman to handle his train with ease and accuracy.

The compressed air is supplied by a pump operated by a 3 horse power motor. In connection with this a novel device has been introduced, comprising a starting rheostat operated by air and regulated according to the pressure in the reservoir. When the pressure exceeds the normal, the motor is automatically stopped, and as the pressure drops, the starting rheostat operates and the pump resumes its work.

The current is carried from the power station to the trains through a conductor consisting of a T rail, supported on insulating blocks just outside of the tracks. Four sliding shoes, two on each side of the car, make the connection with the conductor, the current returning through the wheels to the rail, and thence through the steel girders of the superstructure to the power station. To make the necessary connections between girders, large plates of copper have been riveted to the steel with copper rivets.

The superstructure is essentially of wood; 12 inch by 12 inch yellow pine posts set on concrete foundations support a heavy cap of the same material, on which rests the 15-inch steel I beams. On the top of the I beams the ties are laid and bolted. Four guard timbers form a part of each track and distribute all stresses produced by the starting and stopping of trains.

The power plant of the railway has a capacity of 3,700 kilowatts and is equipped with the latest approved forms of apparatus. The generators include a 1,500 kilowatt machine, directly connected to an Allis cross compound condensing engine; a 750 kilowatt, directly connected to an Allis tandem compound condensing engine; a 750 kilowatt directly connected to a Williams compound condensing engine; a 500 kilowatt belted to a Greene tandem compound condensing engine, and a 200 kilowatt, directly connected to a MacIntosh & Seymour tandem compound condensing engine. The pumps and condensers used are the Allis, the Worthington, the Gould, the Deane, and the

Smith-Vaile. The boilers, ten in number, were built and installed by the Babcock & Wilcox company and they are equipped with the latest appliances for burning oil. The combined gases, in going to the stack, pass through a water heater built by the Greene Fuel Economizer company. The entire electrical equipment of the railway was furnished by the General Electric company.

With a headway of three minutes or twenty trains an hour, the capacity of the road is 16,000 passengers per hour. To handle such large crowds with speed and safety it was found necessary to equip the track with a complete block signal system. The work has been done by the Rowell-Potter Safety Stop company of Boston, Mass. The apparatus is in the main mechanical, electricity being used only to release the block and set the signals at safety. The principal feature of the system is found in a device which throws off the current and sets the brakes on the train in case the motorman runs past a danger signal. A signal out of order acts likewise, excepting that notification is at once given to the motorman.

The officers of the company are: B. E. Sunny, president; E. C. Ward, secretary; W. E. Baker, general manager; C P. Matlack, chief engineer and superintendent; C. H. Macloskie, electrical engineer; R. I. Sloan, consulting engineer for superstructure; B. J. Arnold, consulting engineer and construction engineer for power station; G. K. Wheeler, consulting engineer for electrical equipment.

Exhibitions, Industrial, National, International and Electrical.

By W. J. Hammer.

Industrial exhibitions, contrary to many people's understanding, are of very ancient origin. Even the Olympic games had for over 1,100 years their industrial and artistic elements, and the great fairs of Astrakan, Nizhnee-Novgorod, Prague and Leipsic have been carried on for very many years.

The first great fairs instituted in France and Southern Europe were held about 1,310 years ago Among the more celebrated of the early ones are those of St. Denis, A. D. 629, Aix-la-Chapelle and Troyes about 800 A. D.; and they were carried into England in 886 A. D., and at the end of the 10th century they had become very common throughout Northern Europe. In 1797 steps were taken in France to organize at St. Cloud an industrial exhibition of carpets, tapestry and porcelain. This, the earliest French exhibition owed its conception to the tremendous spasm of the French Revolution. These arts were originated and fostered by Colbert and afterward maintained by the monarchy, and the exhibition was undertaken by the Marquis d'Avise by the authority of the Directory. The goods were to be exhibited and disposed of by lottery, but the day, preceding the opening, the exhibition was forbidden and the military commander, Augereau, put in possession. The Marquis d'Avise was compelled to leave Paris, a proscribed nobleman. This energetic and enlightened noble returned in 1798, and under the old regime organized an exhibition in the Maison d'Orsay and adjoining grounds. It remained open until General Bonaparte, the future first counsel and emperor of France, returned from his first brilliant Italian campaign and laid his magnificent spoils at the feet of the Directory. The exhibition was then moved to the Champ de Mars where it lasted three days and consisted of 110 exhibitors.

In 1801 the second exhibition was inaugurated by Napoleon, who had become first consul, and was held in the Royal Louvre for six days, with 229 exhibitors.

The third was held in 1802, and opened by Napoleon in person. This was fourfold larger than the preceding ones and lasted seven days with 540 exhibitors.

The fourth was held in 1806, under the empire, and lasted twenty-four days with 1,422 exhibitors.

In 1819 Louis XVIII. opened the fifth exhibition, lasting 35 days with 1,662 exhibitors, in the Louvre, and the king then decided that such exhibitions should become permanent national institutions to be held every fourth year.

In 1823 the sixth exhibition under Louis XVIII. was held in the Louvre, lasting 50 days with 1,642 exhibitors.

In 1827 the seventh exhibition under Charles X. was held in the Louvre, lasting 62 days with 1,695 exhibitors.

In 1834 the eighth was held under Louis Philippe, lasting 60 days with 2,447 exhibitors. The change of dynasty and political confusion prevented the ordinance of Charles X from being carried out three years before.

In 1839 Louis Philippe opened the exhibition in the Champs Elysees, lasting 60 days with 3,281 exhibitors.

Five years later, in 1844, Louis Philippe inaugurated the tenth exhibition, the last in his reign, running for 60 days with 3,960 exhibitors.

In 1849 the eleventh exhibition was opened by the new republic shortly after the dethronement of Louis Philippe. This lasted 60 days with 4,494 exhibitors. The growth and interest of these French exhibitions had begun to attract the serious attention of the governments of other continental countries, and in 1845 the King of Bavaria constructed the first permanent exhibition building at Munich.

It is also claimed that a proposal was made as early as 1844 to hold an international exhibition in England, although it is generally believed that the credit for the original conception of an international exhibition or World's Fair is due to Prince Albert, the Prince Consort of England, who in 1849 suggested the matter to the Society of Arts of London, of which he was the president. The first International exhibition was held in 1850 at the Crystal Palace in Hyde Park, and although the first development of national exhibitions in contra-distinction to the country fairs held previously was due to the prescient mind of Napoleon in his early prime, to the English is undoubtedly due the credit for the organization of the first World's Fair or International exhibition. The wonderful success of this exhibition aroused the spirit of emulation in other countries and steps were taken simultaneously to hold exhibitions in Dublin, Paris and New York. The latter was the first to open and was held in 1853, adjoining the Croton distributing reservoir on Fifth avenue between Fortieth and Forty-second streets.

The same year, the Dublin exhibition was opened and following that, the one in Paris in 1855. Others followed in rapid succession, and among the most important of these are the following: London, 1862; Paris, 1867; Vienna, 1873; Philadelphia, 1876; Paris, 1878; and Paris, 1881; London and Munich, 1882; Vienna and Amsterdam, 1883; Philadelphia, 1884; New Orleans, 1885; Paris, 1889; London 1892; that of 1881 at Paris being the first international electrical exhibition which had ever been held. It was opened August 11, 1881, and met with remarkable success. This was followed in the spring of 1882 by the Crystal Palace electrical exhibition, this being in turn followed by the electrical exhibition of Munich, which opened September 17, 1882.

In the following year, 1883, a second electrical exhibition was held at the Crystal Palace in combination with a gas exhibition, one-half of this magnificent structure being given up to each of the two systems of illumination. It is interesting to note that while the previous electrical exhibition had been exceedingly profitable to the Crystal Palace management, they suffered a considerable loss in the second exhibition owing to the great damage done by the gas to the tropical foliage, rare plants and vines with which the Crystal Palace was filled and for which it was justly noted; and in the smoke abatement and gas exhibition held shortly thereafter at South Kensington, it was claimed that the Royal Horticultural society suffered a loss of thousands of pounds, many valuable plants placed in their care being destroyed, due to the deleterious effect of the gas, the huge Siemens regenerative burners which had just come into use, being largely responsible for this. The use of the electric light has been demonstrated to have no such injurious effect, and in fact, the experiments of Siemens and others have proven that vegetation flourishes under the electric light, and the writer has seen strawberries and other fruit and plants which have been brought to perfection without the aid of sunlight, and solely by the aid of the electric light. Some of these have been exhibited at the various electrical exhibitions.

Immediately following the Crystal Palace exhibitions and the Munich exhibition, came the Electrical exhibition at the Aquarium in London, and about the same time the Electrical exhibition at Vienna, which took place in 1883, and in the same year the International exhibition at Amsterdam, Holland. Then followed the Electrical exhibition at Philadelphia, under the auspices of the Franklin Institute in 1884, and in the same year an International exhibition was held in Turin.

The next great exhibition was held in New Orleans in 1885. Passing over the Health, Fisheries, Inventions and American exhibition held in London about this period, and that of Spain shortly afterward, and other exhibitions of more or less importance in other countries, we come to the marvelous exhibition of Paris in 1889; then followed, in 1890, the electrical exhibition in Edinburgh, which in turn was followed by the electrical exhibition at Frankfort of 1891. The principal features at the Frankfort exhibition of 1891 were the interesting experiments in transmission of power employing the three-phase system. Following this was the electrical exhibition of 1892, held at the Crystal Palace.

With the exception of the telegraph, the last 15 or 20 years have witnessed the commercial development upon any considerable scale of practically all of the applications of electricity to the industrial arts, as we see them to-day. The writer proposes to give a brief summary of some of the most important electrical features, the birth of commercial development of which has been contemporaneous with certain of the International exhibitions, electrical and otherwise, already mentioned.

It may surprise many of the readers of the Western Electrician to find that practically all of the leading principles of the electric telegraph were enunciated prior to the first international exhibition in London of 1851. Before that year some thousands of miles of iron wire had been stretched upon insulators upon wooden poles in the various civilized countries, and a system of underground telegraph, using wire insulated with gutta percha, had been used in Germany, and disclosed the phenomena of lateral induction, which plays so important a part in the submarine telegraph of to-day. Submarine telegraph circuits were proposed and carried out, to cross the Rhone at Cologne, and other rivers, although the end of 1851 marked the laying of the first submarine cable between Dover and Calais.

Up to this time, various telegraphic systems had been used embracing the needle, dial and recording; worked with battery, and magneto electric machines, type printing, mechanical, recording, Bakewell's autographic, and the acoustic instruments of Dujaroin and others were employed, and the advances since have been mainly in scientific and practical development of principles, embodying, of course, the results of deep researches, and inventions of the utmost importance. The London exhibition of 1862 showed many applications of electricity, including those of telegraphy, railway signals and alarms, electro-plating, the Serrin arc lamp, Murray and Heath's arc lamp, the Holmes and Berlioz dynamos, and a great variety of test instruments, switches, insulators, cable, etc. Wheatstone, Wilde, Breguet, Siemens and Halske, d'Arlincourt, Dujardin, Bonoelli, Digney Freres, T. Allen and Jacob Brett exhibited various systems of automatic, telegraphic, ink recording, chemical embossing, Roman type and Morse telegraphic systems.

The Paris exhibition of 1867 also showed a large collection of similar applications of electricity. Among the most interesting things exhibited were Ladd's dynamo, which was said to have been the most astounding object in the Champ de Mars. This dynamo, according to the official report of United States Commissioner Samuel F. B. Morse, maintained at a white heat a yard or more of platinum wire one-half a meter or more in diameter, and gave a current equivalent to 25 or 30 Bunsen elements, and was constructed from borrowed plates of Wilde's magneto-machine, Ladd substituting electro-magnets, and adding a second armature and applying the dynamo principle of Siemens and Wheatstone of 1866. The machine of Soren Hjorth of Copenhagen, which he termed his magneto-electric battery, Day's Kerite wire was also exhibited and attracted very favorable attention, and the thermo-electric battery of Moses G. Farmer was shown, both of the latter being American exhibits.

The 1873 exhibition at Vienna showed a most interesting display of the various telegraphic systems, particularly those of the automatic systems of Siemens and Wheatstone, Gustav Jaite, Edison and Little, Meyers, Hughes' printer, Morse's register, the Siemens polarized relay, various types of batteries, including the Grove, Daniel, Bunsen, and Callaud types, Stearns' system of duplicating of telegraphic lines were shown, and Breguet, Siemens Bros., and Siemens and Halske exhibited resistance units based upon the B. A. unit and the mercury unit, the latter unit having been adopted at the Convention of Vienna in 1868, and affirmed at the Rome Convention of 1872.

Historical exhibits were made of Sommering's telegraph of 1809, Schilling's needle telegraph of 1832, Gauss and Weber, used from 1832 to 1838; Steinheil's of 1837; and Nottebohm, Siemens, and others exhibited lightning arresters, measuring instruments, mirror, sine and tangent galvanometers, portable bridges, battery testers, galvanoscopes, fire alarms, electric bells, dynamo blast exploders, by means of sparks and by heating wire; and Hefner-Alteneck, of Siemens and Halske, exhibited his dynamo for strong currents; a dynamo and head-light for the locomotive was shown, and hand electric lamps with Fresnel lenses.

Then followed the Centennial exhibition of 1876 at Philadelphia. Probably the most important electrical features connected therewith were the Bell telephone, which was first publicly shown there, the lighting of exhibition buildings for the first time by means of electric light, which

was carried out with the Wallace-Farmer dynamo and the Wallace plate carbon lamps.

Breguet exhibited some of the Gramme dynamos and Wallace showed his large Centennial copper plating machines. Gray's harmonic telegraph and other objects of great interest were shown.

In Paris in 1878, an interesting exhibition was made of telegraphic, telephonic, and electric arc lighting apparatus and metallurgical appliances were shown, and in 1881, the wonderful International electrical exhibition was held in Paris.

Space will not permit the writer to give a list of all the marvels shown there, but among the most important were the first extensive public display of the Edison and the Swan incandescent electric lamps; Edison's magnificent display of his various inventions, the feature which attracted the most attention being his huge steam connected dynamo, weighing about 22 tons; Maxim's automatic dynamo regulator, Siemens' electric railroad, which had been shown by him at Lichterfelde shortly before and about the same time that Edison was making his experiments with the electric railroad in America; Deprez motor; the electric candles of Jablochkoff, at that time so well known, and Jamin, and the Siemens la Soliel, Jasper, Crompton, Brush, Werdemann, Maxim and other arc lamps in infinite variety, and dynamo machines of the Gramme, Siemens, Edison, Brush, Lontin, Maxim and many other well known types. A room fitted up with telephones connected to microphones at the Grand Opera House attracted enormous crowds, and among the scientific men who visited the exposition much interest was manifested in the remarkable collection of works upon electricity and magnetism, the most compl te library in the world, which was exhibited by the owner, Latimer Clark.

Many of the exhibits at Paris were sent to London, to the Crystal Palace Electrical exhibition, which followed immediately thereafter in 1882, and while of very great importance, possessed comparatively few striking features, which had not been already shown in the Paris exhibition. Edison's magnificent display, which was the largest feature in the Paris exhibition, was added to and became the most prominent feature at this exhibition also, and as in the Paris exhibition the telephone occupied a very prominent place, Prof. Dolbear's electro-static telephone attracting particular attention, and this department vied with the extensive displays of arc, incandescent, and semi-incandescent lamps. The telegraph department was very complete, and among other interesting things shown, were Lord Kelvin's siphon recorder and Edison's automatic and autographic telegraph, which were also shown at Paris. A small electric railway carried passengers in the grounds.

At the Munich exhibition in 1882, the interesting experiments in electric transmission of power by Marcel Deprez, and in storage batteries, added considerable interest to the fine display of electric lighting, telegraph, telephonic and other experiments.

At the Vienna exhibition of 1883, was shown the electric launches driven by the storage battery, a fine display of electrically operated pianos, a series system of incandescent lighting with Bernstein lamps, and a most wonderful collection of dynamos, motors, arc and incandescent lamps, telephones, telegraphic systems, and a beautiful display of electro plating work. The Electrical exhibition held in the same year at the Aquarium in London brought out for the first time publicly the Gaillard and Gibbs transformer.

At the Turin exhibition in the following year this same system, which has now become so well known as the alternating current system, was shown on a commercial scale, and some elaborate tests were conducted, demonstrating its practicability and efficiency. Following this was the Franklin Institute Electrical exhibition held in Philadelphia in 1884, which, while considered an International exhibition, was largely an American exhibition, but of great interest and importance. The various large electric lighting companies made handsome displays and the telephonic interests were strongly represented, and Prof. Gray; William Wallace, and others made historical exhibits of very great interest; and one of the most interesting features was the efficiency test upon the various incandescent lamps shown at the exhibition. At this position was shown the first flashing tower of light composed of incandescent lamps, designed by the writer, which has since become so common at the different electrical exhibitions. The mammoth incandescent lamps of Weston and Edison, Edison's huge steam dynamo, electric clocks, the curious plating machines of Forbes and others, the different types of dynamos and new incandescent lamps, the Sprague electric motors, and a conduit system for electric railways were among the salient points of this exhibition.

The next important exhibition was that of New Orleans in 1885. The most interesting electrical features shown there were the immense plant constructed for the lighting of the building by the Edison incandescent light, and the Daft electric railway, and besides these there were the usual exhibits of telegraphic, telephonic systems and dynamos for arc and incandescent lighting and plating purposes. Electricity played a more or less important part also at the small exhibitions at Louisville and elsewhere, and at the Centennial exhibition of the Ohio Valley and Middle Atlantic states, held at Cincinnati in 1888, where was shown the largest display of electricity, producing novel effects as an attraction to an exhibition that had ever been produced in this country or abroad, and it is doubtful if a greater display has been made since, of electricity utilized in this particular manner.

The Paris exhibition of 1889 had many important electrical features. Among the most important were the personal exhibits of the inventions of Thomas A. Edison, the apparatus for experiments in induction and in alternating currents of Elihu Thomson, the electric welding system of the Thomson-Houston company, the electric railway system of the Thomson-Houston, Sprague and other companies, the huge direct current dynamos of the Oerlikon company, the various accumulator systems, and the extensive appliances for railway, telegraph and signaling purposes. The immense search lights, the largest which had been up to this time constructed, attracted a great deal of attention, and the high speed dynamos driven direct by the steam turbines received merited attention. The powerful permanent and electro-magnets and Deprez electric hammer were interesting features, the types of direct driven dynamos exhibited in the French, German, English and Belgian sections, and the huge incandescent dynamo exhibited by Edison and the alternating current machines of the Thomson-Houston company all attracted an enormous amount of attention and showed great advances in the art of dynamo construction.

Following this came the electrical exhibition of 1892, held at the Crystal Palace exhibition. This, although termed an International exhibition, was largely devoted to English manufacturers. It was very interesting to compare this exhibition with the Electrical exhibition held ten years previous, at the same place, both of which the writer had the pleasure of attending. The most interesting features shown at last year's exhibition were the high-tension experiments of Siemens Brothers and Messrs. Swinburne, the experiments, with alternating current apparatus of Elihu Thomson, the electric steam fire engine of Siemens Brothers, the improved forms of Plante storage batteries, the various types of electrical meters and testing instruments, Crompton's electric crane, the Kingdon inductor dynamo, Morday's alternating current machine, the handsome display of electric motors and methods of controlling the same, the Carpenter heating and cooking appliances, and the fine display of the Edison-Swan Incandescent Lamp company, and last but not least, the very interesting display of historical telegraphic apparatus by the British Postoffice Department.

This brings us about up to date on the most important of the exhibitions of the past, and to the threshold of what will doubtless prove the most remarkable exhibition that the world has ever seen, and let us hope that from an electrical standpoint, it may surpass in importance all the electrical exhibitions which have heretofore been of such incalculable interest and value, and in conjunction with which so many valuable discoveries and inventions have been brought to the attention of the public.

Varied Applications of Electricity.

By E. J. Spencer.

It was at the very beginning of exposition work that the Edison General Electric company obtained a contract for the furnishing of the temporary light and power plant for the exposition. By the fall of 1892 this plant had increased so as to call for four arc lighting machines, two 100 kilowatt 500 volt power generators and two low tension incandescent machines. From its installation until within a month this plant has done continued, incessant duty under the most trying circumstances of overload, of hastily improvised expedients and generally discouraging surroundings. A plant put in for the immediate needs of the time, it has continued many months beyond the originally estimated period of service. Although installation was of a temporary character, the service has been uniformly reliable and satisfactory. Many motors have been placed throughout the grounds and buildings of the exposition for hoisting, running saw-mills, pipe cutting machines and a multitude of other original applications that have reflected the greatest credit upon the ingenuity and the competence of the electrical and mechanical departments of the World's Columbian Exposition.

Thoroughly appreciating the service, the Exposition company has awarded the General Electric company the contract for furnishing motors from one to 100 kilowatts capacity for service of the World's Columbian Exposition during the year 1893. At the opening of the Fair there will be a multitude of motors, ranging in capacity from one to 130 horse power, engaged in all the varied service of this vast aggregation of wonders.

In the service lighting of the grounds and buildings the General Electric company will have an aggregate of 3,500 2,000 candle power arc lamps. The largest building of the exposition (manufactures) is lighted by the Thomson-Houston system exclusively, after designs prepared at the solicitation of the World's Fair under the direction of the General Electric company. These plans in all their studied detail reflect the greatest credit upon the noted lighting engineer, Luther Stieringer, who devised this novel method of even distribution of light; also upon the exposition's civil engineer who designed, contracted for and placed the structures requisite for this most difficult piece of lighting work. It is safe to say that the large coronas of the manufactures building are without a rival in the lighting art.

To the same master hand designing the lighting of the manufacturers and liberal Arts building is due the design of the great electric fountains, put in by the General Electric company at the west end of the grand basin, facing the administration building. These fountains, two in number, placed on the lower terraces on either side of the McMonnies emblematical fountain, are without a rival in ancient or modern days in hydraulic or electrical design. Supplied from the high pressure system placed for the fire protection of the World's Fair by the Worthington pump people, each of these two fountains requires for its own individual service the full capacity of a 16 inch water main under 100 pounds pressure. Located as they are upon the lower terraces, the necessity arose for operating casemates below the surface level of the lake. The successful completion of these water-tight casemates, with their floors seven feet below the level of the water in the adjoining lagoon, reflect the greatest credit upon the FitzSimons & Connell company, engaged upon this contract.

In illuminating these fountains the General Electric company had at its command the experience in projector work for the United States navy. Altogether, 38 of their 90 ampere projector lamps, with burnished silver parabolic reflectors, will, by their concentrated effort, illuminate in the most pleasing manner the ever varying streams of water projected through the nearly 400 apertures provided. The entire management of these fountains will be directed from the northeast tower of machinery hall. By means of the devices employed both fountains can be made to operate as one. For maintaining the light there will be used four 175 kilowatt Edison bipolar generators, the service to each fountain being on the Edison three-wire system, with lamps placed across the mains in parallel. After the close of the evening's entertainment the same machines will be used in charging the batteries of the electric launches. After five or six hours charging each little launch will have stored away in its hold about 40 horse power hours of effective electrical energy, sufficient for 10 or 12 hours continuous run. This charging station, located south and east of the agricultural building, is the most extensive ever put in in the United States, and probably in the world.

Upon the United States battleship Illinois the General Electric company will show its method of ship lighting and the distribution of electricity for general ship uses. Two standard naval direct coupled, iron clad generating sets will be located between decks. In all her fixtures, her side lights, mast head lights, binnacle lights, lights for cabin, for magazine, for coal bunkers and for all other purposes aboard ship, the appliances of the company will be shown. Here also will be actively displayed several of its search light projectors; one of the largest projectors ever made in the United States, or even in the world, a 150 centimeter projector with a 200 ampere lamp.

Of the intramural railroad, suffice it to say that this most interesting and most valuable demonstration of the applicability of electricity to high speed interurban service is looked upon with the greatest interest throughout the country. The freedom from smoke and dust, from smell and discomfort, from overwrought sympathies at brutal treatment and overloading of sensate animals, together with the attendant comforts of well lighted and cleanly cars, will do more to assist in the popularizing of surburban life than any advance thus far made in the science of transportation. The flexibility and reliability of its system, the easy extension of carrying capacity

without a diminution of schedule time due to overloading of engines, the easy extension of capacity without consideration of limits of strength of structure will all be arguments in favor of electric traction strongly appealing to those most interested in elevated railway service.

It was about a year ago that the attention of the companies now forming the General Electric company was directed toward the Columbian Exposition and the chance afforded thereby of displaying in competition with the world the advances made in electrical development by American manufacturers. It was then that application was made for allotment of space of exhibit in electricity building. Due to numerous partial pledges by the department of electricity and the consequent necessity of effecting several mutual transfers in space alloted, it was late in the fall before the assignment of space as now possessed by the General Electric company was made in its favor. This final assignment of space gives to the company the central spaces of the building. These spaces are five in number. In the very center of the building is a space 34 feet in diameter where the General Electric company has erected a beautiful shaft which, with its decorations of thousands of incandescent lamps, will be an appropriate central feature of the electrical exhibit of the exposition. The entire length of transept, from the east door to the west door, has been assigned to this company, together with the spaces in the nave similarly situated and immediately adjoinig the center. On either hand, immediately under the galleries, the spaces adjoining the central areas have also been given to the General Electric company, thus securing for its exhibit the entire central space of the electricity building, comprising over one-quarter of the ground floor of this building, and fully one-seventh of the entire exhibit space available.

But this is not all; for in the contract for arc lighting, for motor service, for the great electric fountains, for service to the electricity building, for the charging of the storage battery launches, for the equipment of the Intramural railroad, for the equipment of the United States battle ship and for search light projectors sweeping the entire horizon, the General Electric company has acquired at the World's Fair business interests far exceeding the purely exhibition features.

As for the exhibit in the electricity building proper, it scarcely need be said that nothing of modern useful application of electricity to service has been overlooked by the General Electric company, and all these applications will be illustrated, in fact or in photograph, within the area of this exhibit. In the one space stands the "Jumbo," the first instance of a direct coupled engine and dynamo. Showing the crudeness of the early days of its design, it still surely pointed the way to the modern type of dynamo with direct coupled compound or triple expansion engine with efficiencies approaching the possible limit, and capacities of titanic extent. This exhibit is loaned by the New York Illuminating company, in whose Pearl street station the machine has done service for eleven years. In the same space will be shown the incandescent lamp of every type and voltage; and the only comprehensive system of distribution by feeders and mains. In the east center space will be shown the alternating system with all its devices and in all its possibilities. Across the center aisle its offspring, the multiphase system, will appear in another exhibit. The application of electricity to marine service by high speed engines directly driving small compact highly efficient dynamos, the search light projector, and the dock and marine hoist, the uses of electricity in pumping, its perfection in devices for signalling at sea, will also be shown. The various applications of electricity to the needs of the miner and the perfected systems for the transmission of power over long distances will also be evidenced; the standard motor and motors applied to locomotives, to derricks, to elevators, will also be shown. We must not omit the display illustrative of the development of street railway service nor the generators that up to a short time ago would have been considered as impossible creations.

The model arc lighting plant, rendering the service lighting for the electricity building, will be in one location, and last but not least, the incandescent lamp in all its decorative and service phases will be most lavishly used.

Expositions have become more and more extravagant in expenditure and exhibitors have spent more and more of time and money in the attractive placing of perfected exhibits before the public eye. The Columbian Exposition is no exception to this rule. The grounds and the buildings are marvels of creative genius. The exhibits, particularly the electrical exhibits, will be equally excellent. Fortunate the man whose privilege it will be to have sufficient time for a proper enjoyment of the beauties of the World's Columbian Exposition, and especially fortunate he, whose time is at his command and whose training is such as will enable him to benefit to the fullest extent by the opportunity for study offered by the electrical exhibits at the World's Fair.

Commercial Advancement of Electrical Interests.

By W. H. McKinlock.

The commercial side of the electrical industry can really be confined to little more than a decade. When Alexander

Graham Bell exhibited his electric telephone at the Centennial Exposition at Philadelphia in 1876, there were a few manufacturers in the country making medical batteries, telegraph instruments, the fire alarm telegraph, electric bells and burglar alarms. Everyone knows that outside of the manufacture of telegraph instruments (which was controlled by a few factories) the electrical business as a commercial problem was not considered a factor and hardly, if any, attention was give to it. None but the very best of hotels could pay the prices demanded for electric bells, and only the very wealthy could afford the luxury of a burglar alarm; therefore, the production was limited.

The public did not take kindly to the telephone at first, and it came into favor grudgingly. It was 1880 before it could be said that its success was assured. The manufacture of the special devices used in connection with the telephone was performed in a circumscribed manner, and naturally fell to the lot of factories already equipped and having some experience in electrical matters. Nearly or quite contemporaneous with the telephone, the electric light appeared. The growth of the electric light may be said to resemble in part, "Jonah's gourd," maturing in a night. The business was found highly profitable, capital was attracted to it, new factories were started to supply the demand that seemed insatiable, the larger cities adopting it with avidity and the smaller ones following in their steps as rapidly as they could be supplied. The constant changes made necessary by the lack of understanding and requirements of the business and the rush and hurry to take orders by the manufacturers supplying their particular system or systems created a new industry, which is now commonly known in the trade as the "supply house."

The growth of the supply house must necessarily be commensurate with the growth of the general business, and commercially, it is looked upon to-day as a large factor of it. There are millions of dollars invested in these various enterprises throughout the country, and while the business is not considered a technical one, still it is necessary to have a fair knowledge of the general appliances and to know the requirements of the trade, together with a good business training and sufficient capital to conduct a house of this character with profit. At this period capital is no inconsiderable element as a component part of a successful supply house.

The supply house is designed to be a place where the station manager can send for a screw driver or an extra dynamo, where he can get his pound of magnet wire to repair a burn-out, or miles of wire, poles, cross-arms, pins, brackets, lag bolts, and step irons, to construct a new circuit. He has come to recognize the supply house the same as a house-keeper does her groceryman, and buys simply his daily needs. A well conducted supply house is supposed to carry all the materials, with the exception of the main machines, in stock, and in quantities, too, to meet any demands that are made.

The supply man has had much to do with perfecting the electrical business in general, competition having made it necessary to develop articles of merit and superiority if his particular house is to enjoy any advantage in the trade. In this way they have perfected, and have had perfected, numerous auxiliary appliances that have augmented the uses of electricity, in the house, store, railway, steamboat, factory and otherwise.

The progress of the electric railway has given a new impetus to the business and has enlarged its scope, developing its resources and giving a new and vital element to its character. The wide-awake supply man often can and does supply to the engineer and expert ideas and opportunities for the better carrying out of his plans, for he is obliged to keep himself posted on every new thing that is brought out, and generally tests its merits before offering it in the market.

Much has been said about the progress of the electrical industry, but very little, if anything, with reference to the supply business, and yet a review of its short history is fully as wonderful, if not more so, than any other single feature or branch of the electrical industry as a whole.

What development it can show at the World's Fair, which now is upon us, can hardly be appreciated, as it can only be looked upon in the aggregate. In 1880 there was an approximate capitalization of supply dealers and manufacturers of supplies of about one million dollars, with possible annual sales amounting to twice that amount. At the present time, at a low, conservative estimate, there is forty millions invested in the supply business, and manufacturers of supplies that do a business of three times that amount. These figures do not include manufacturers of wire nor patented articles, but represent the manufacturers and dealers of apparatus that is auxiliary to the general business, and to such as is dealt in universally by supply houses.

The decade we are now in bids fair to rival the one preceding it, if not entirely surpass it. The electrical congress that is to be held during the fair will mean a good deal to the supply people, and will no doubt settle many mooted questions respecting the technique of the business. The practical application must necessarily fall upon the workers, and the appliances, to some extent, must be worked out by these men, assisted in a great measure by the experienced supply man.

To those who will give some thought and study to the electrical business the phrase so often heard, that the business is "still in its infancy," must appear ridiculous. Any business with a billion dollars invested in it must be something more than an experiment, and the electrical business as a whole has reached this basis. If one should attempt to estimate the future by the past, he would require to have an unusually imaginative mind, and yet, we should soberly judge the future by the past, and estimate ourselves judicious in so doing.

Electric Launches on the Lagoons.

By C. H. Barney.

A novel means of transportation, and one that will prove a most attractive feature of the World's Columbian Exposition, will be the fleet of fifty electric launches, which will make regular trips over a course of about three miles on the lagoons and other interior waters at Jackson Park. The plan of water connection was first conceived by Frederick Law Olmstead, the landscape architect of the exposition. These boats will run from 8 A. M. until the fair closes at night, and the landings on the course will enable passengers to get on or off at any of the buildings or other points of interest, thus affording means of communication between different parts of the grounds, as well as a most delightful method of obtaining a general view of the magnificent buildings which front on the lagoons and canals.

The course to be taken by the launches will be from the north side of the agricultural building along the south side of the manufactures building, thence up the north canal through the east lagoon, turning into the north inlet, passing the fisheries building to the clam-bake landing, thence back again through the inlet and into the north lagoon to the fine arts building, and from there returning down the west lagoon and north canal to the starting point. The landings will be as follows: Agricultural building, north side; liberal arts building, south end, southwest corner and west centre; government building, north side; fisheries; clam bake; Illinois state building; woman's building; horticultural building; transportation building; mines and mining building; electricity building, northeast corner and southeast corner. The round trip will occupy about fifty-two minutes. When a launch returns to its dock at the charging station from its forty miles run, the work of charging is begun in less than one minute by an independent switch board connected to feeders from large dynamos in machinery hall. For the ten to twelve hours run a charge of five to seven hours at an average rate of 15 amperes will ordinarily recharge the batteries. The boat shed and charging station will occupy the east and south sides of agricultural annex.

As may be supposed, the competition for this valuable concession was very great. Several concerns were bidders, and each of them was required to build a boat to be submitted to trial tests during the months of June and July last, to determine which class of craft was best suited to fulfill the requirements of passenger traffic on the exposition waterways. Steam, naphtha and electric launches were tested, and the electric boat Electra, owned by the Electric Launch & Navigation company of New York, was declared the best suited for the work.

The general dimensions of the boats to be used will be 35 feet 10 inches in length over all, with a beam of 6 feet 3 inches and a draft of 28 inches. They will seat comfortably about thirty passengers each. The motive power will be furnished by storage batteries, manufactured by

the Consolidated Electric Storage company, and motors especially designed and constructed by the General Electric company. The batteries and motor are placed beneath the seats and flooring, so that the utmost carrying capacity of the boats can be utilized. These launches are, of course, absolutely free from smoke, grease, offensive odors and vibration. The boats will be carpeted with perforated rubber mats, with a solid canvas backing to catch all dirt and water. The cushions are of leather, stuffed with hair. The awnings and side curtains are striped orange and black, pattern and color selected by F. D. Millett, director of colors. For the use of officials, the exposition has purchased four boats, similar to those in regular service, but with decks and interior more highly finished and having different colored awnings.

Each boat in actual daily operation during the fair will cover on an average forty miles a day, with one charge. The total mileage per day for the fifty launches will therefore aggregate 2,000 miles, or more than the distance from New York to Chicago and back each day.

The normal speed—all that is allowed by the World's Fair—is six miles per hour. A speed of eight miles per hour is, however, attainable on emergencies.

In the equipment of these launches a 4 horse power motor is directly connected with the propeller shaft. The speed of the motor is controlled by means of a lever within easy reach of the pilot. For regular service such as that required at the exposition, where moderate speed is desired, the batteries are grouped either in two or three divisions. In the latter case twenty-six cells are connected, giving 42 to 45 amperes at 52 volts. The other grouping consists in putting the 78 cells in each launch in two groups of 39 cells in series, giving about 55 amperes at a pressure of 78 volts. This grouping is adopted to prevent too rapid discharging of the batteries and to give a steady and continuous current to the motor.

The officers of the company are: President, Henry Steers; vice president, E. J. Moore; secretary and treasurer, Alfred Skitt. The officers in immediate charge of the operation of the concession on the grounds are: General manager, C. D. Wyman; superintendent, C. H. Barney; electrical engineer, R. N. Chamberlain.

Illustrated Features.

The illustrations presented in this number of the WESTERN ELECTRICIAN will give an excellent idea of the principal electrical features of the World's Fair and some of the men who have been prominently identified with the project. They will materially aid the visitor in studying the electrical part of the great exposition. A full page portrait of Prof. John P. Barrett, chief of the department of electricity, is presented as a frontispiece. It is an excellent likeness of the man who will occupy the most prominent position among the electrical fraternity of Chicago during the exposition.

Views of the electricity building are presented on pages 228 and 229, showing the progressive steps in the erection of the structure. The first three cuts are reproduced from the WESTERN ELECTRICIAN of May 3, 1891, February 9, 1892, and September 3, 1892. The first of these is a perspective view, prepared for this paper, which was adopted by the department of publicity and promotion, and reproduced in newspapers and magazines in every part of the country. Following this is a photographic view of the building as it appeared nine months later, when the great steel arches had just been placed in position. The third illustration shows the appearance of the building last fall, just before the dedicatory exercises. The fourth and last view of the building is from a recent photograph showing the structure complete.

A map of the central portion of the city, in which a majority of the electrical concerns are located, is presented on page 230, and two bird's eye views of Jackson Park, one from the lake and the other from Hyde Park, are given on pages 238 and 239.

Diagrams showing the arrangement of space in electricity building are presented on page 232. These plans are from the latest official records, and the assignments shown may be taken as final.

On page 226 is a useful map showing the location of all the principal electrical features on the grounds. By its aid the visitor can readily ascertain the location of any display he may be particularly desirous of seeing.

The beautiful illustration on page 227 is a reproduction of the latest photograph of machinery hall, and shows this handsome building to advantage.

A plan of the power plant in machinery hall is shown on page 240. The drawing shows the southern portion of the main building and the southeastern corner of the annex, within which the electric lighting and power machinery is comprised. This great plant has heretofore been described in detail in the WESTERN ELECTRICIAN, but the following recapitulation will be of service:

Boilers—Root, 1,500 horse power; Gill, 1,500 horse power: Heine, 3,750 horse power; National, 1,500 horse power; Campbell & Zell, 3,750 horse power; Babcock & Wilcox, 4,500 horse power; Stirling, 1,500 horse power.

Engines—Ball (1), 480 horse power; Armington & Sims (1), 400 horse power; Edison (1), 1,000 horse power; Phœnix (3), 1,000 horse power; Allis (2) 2,500 horse power; Woodbury (2), 1,075 horse power; Ide (2), 425 horse power; Bail & Wood (5), 800 horse power; Fraser & Chalmers (1), 1,000 horse power; McEwen (1), 220 horse power; Westinghouse (9), 7,000 horse power; Buckeye (6), 1,850 horse power; Atlas (2), 1,500 horse power; McIntosh & Seymour (1), 1,000 horse power; Russell (2) 725 horse power; Lane & Bodley (3), 800 horse power; Bass (1), 224 horse power; Watertown (1), 250 horse power; Skinner (2), 400 horse power.

Dynamos—Edison (6), 1,800 horse power; Eddy (4), 1,000 horse power; Westinghouse (20), 120,000 incandescent lights and 500 horse power; Mather (4), 800 horse power; C & C. (6), 600 horse power; Brush (16), 960 arcs; Fort Wayne (14), 840 arcs; Standard (20), 1,000 arcs; Thomson-Houston (26) 1,300 arcs; Excelsior (6), 300 arcs; Western Electric (10) 500 arcs.

A fine illustration of one of the arc light coronas in the manufactures building, alluded to in the articles by Messrs. Pierce and Spencer, in this number, is presented in the full page picture on page 241. This is one of the four smaller coronas and is in the southern end of the building. From it are suspended 78 arc lamps.

Three illustrations represent portions of the great Westinghouse incandescent installation. That on page 237 shows the 2,000 horse power quadruple expansion A lis engine and the two 10,000 light alternators to which it is belted. The engine shown in this picture is the largest in the service plant and is the one set in motion by an electrical connection made by President Cleveland on Monday, from his position in the stand in front of administration building. The engine and dynamos are surrounded by a platform three feet above the flooring of machinery hall, 62 feet long and 37 feet wide. The engine has cylinders 26, 40, 60 and 70 inches in diameter. The stroke is 12 feet. The fly-wheel is 30 feet in diameter, with a face of 76 inches. The dynamos are driven in tandem, the longer belt being 186 feet in length and the shorter 149 feet. These belts were made by the Page Belting company. The handsome Westinghouse switch board described by Mr. Keller is shown on page 231 and a Westinghouse 1,000 horse power engine directly coupled to a 10,000 light alternating current dynamo on page 230.

Undoubtedly the electric fountains designed by Mr. Stieringer will be one of the most attractive features of the exposition. A view of the northern one, from a photograph taken a few days ago, is presented on page 234. It shows the basin and piping. The southern fountain is a counterpart of the one shown. Mr. Spencer, in his article on "Varied Applications of Electricity," gives some interesting facts about the fountains.

"Jumbo" the historic directly connected engine and incandescent dynamo shown in process of rehabilitation on page 233 is the pet of the Pearl street station in New York, where the machine is looked upon almost as an animated being and regarded as an old and trusted friend. It belongs to the Edison Illuminating company of New York, and is merely loaned to the exposition. Such is the attachment that is felt for the veteran that the officials of the company are reported to have declared that the machine could not be purchased at any price. It is said that when the decision was reached to take the machine apart and ship it to Chicago for exhibition many of the employes came up and patted the old-fashioned magnet coils with a husky, "Good-bye, Jumbo." The machine is fourteen years old and has been eleven years in continuous service. So rapid has been the advancement in electric lighting machinery, however, that it has long been regarded as of an antiquated type. But "Jumbo" has a record of faithful service that easily accounts for the fact that it is regarded with a feeling closely akin to affection. Wonderful stories are told of the machine running in three feet of water and of its unmurmuring service to almost any degree of overload. The engine is rated at 140 horse power, but the intimates of "Jumbo" assert that 2,460 16 candle power incandescent lamps have been run from it. The field coils are placed horizontally, eight above and four below the armature, which is of the Siemens type. The dynamo presents an odd appearance when compared with the machines of to-day, but it is most substantially constructed, and bids fair to make glad the hearts of its admirers by many years of continued usefulness. "Jumbo" was one of eight similar machines installed in the original Pearl street station, the first incandescent central station of any magnitude in the world. In its eleven years of continuous service it has averaged five hours a day, with never a skip or break-down. It is no wonder that the admirers of the machine are proud of its record. A machine of this type was exhibited at the Paris electrical exhibition of 1881, where it created a great sensation. "Jumbo" occupies the place of honor in the space in electricity building devoted to Mr. Edison's personal exhibit, and is in charge of W. H. MacKay of the Edison Illuminating company.

The greater part of the arc lights for the general illumination of electricity building will be supplied by the General Electric company, and a view of the plant is shown on page 235. Power is supplied by a 150 horse power Edison motor sunk below the level of the floor, as shown in the picture. Current is taken from 220 volt circuits supplied by Edison multipolar generators in machinery hall. In the plant are nine arc dynamos—eight Thomson-Houston machines, varying in size from fifty-lighters to a little ten-light machine, and one fifty-light Excelsior. The switch-board is arranged for but six machines, however, and some of the machines will not be operated under load. Two of the dynamos are belted directly to the motor, and the others to a countershaft running under the floor.

BOOK TABLE.

THE THEORY AND PRACTICE OF ABSOLUTE MEASUREMENTS IN ELECTRICITY AND MAGNETISM By Andrew Gray, M. A., F. R. S. E., Professor of Physics in the University College of North Wales. 2 Vols. Volume II. Parts 1 and 2. London and New York: MacMillan & Co., 1893.

The brothers Thomas and Andrew Gray have both been assistants to Sir William Thomson at Glasgow, and are therefore in a position to write authoritatively upon many of his methods. The former, now professor of dynamic engineering at the Rose Polytechnic Institute at Terre Haute, Indiana, was, at the time of a visit of the writer to Glasgow, carrying out an extended series of calibrations of Sir William Thomson's new standard balances by determinations of copper in sulphate of copper volt meters. This work was so thoroughly done that his methods and results have formed the standards for sulphate of copper electrolysis ever since. A very full account of them is given in the second of these volumes.

The first volume of this series was issued in 1888 and at once took rank as a treatise on electrical measurement possessing high and unique value, inasmuch as it not only dealt mainly with the more difficult measurements, such as inductive capacity of dielectrics, resistance of electrolytes, calibration of standard wires, the standard ohm, etc., but also gave a solid body of theory, wherein the appropriate mathematics were freely used, but with great clearness and detail. In this way much of the mathematics from Sir William Thomson's "Reprint of Papers on Electricity and Magnetism," and also Clerk Maxwell's volumes was brought in, but in such connection with their experimental applications as to remove almost entirely their abstract and seemingly ideal character when given alone. The electrostatic theory of condensers and cables was given in particularly thorough form, so that a student only partially acquainted with differential equations could nevertheless, by attentive reading, get a good idea of electrical waves along a cable, retardation, distortion of signals, etc. After a long wait ing and much expectation we now have the final installment of this admirable work, in the shape of a volume larger than the first, but for convenience divided into two parts separately bound. The first part of Volume II., with the exception of the author's practical method for the determination of H, is entirely theoretical, but none the less valuable in its place. Much that is given in Clerk Maxwell, or in Mascart and Joubert, somewhat dryly, or in too brief form, is here very clearly, fully and logically presented. In particular, Clerk Maxwell's treatment of the magnetic action of coils and their self and mutual inductance, and the conception of the geometric-mean-distance is enlarged and by including the work of Mr. Macdonald of Clare College, Cambridge, on this latter subject, is made more practically valuable. For example, in addition to Maxwell's results on the geometric mean distance of lines and surfaces, we have others which are now of especial practical value in deciding the arrangement of wires or strips in cable cores, which shall give the least inductive retardations, etc., a question on which the actual relative market values of many proposed forms of underground cables will have to depend. In the calculation of the coefficients of self-induction of coils, we regret that the cases treated are, as usual, the ones where the radii of the coils are large compared with the dimension of the cross section of the windings, whereas the most commonly occurring cases in practice are apt to be just the reverse. On this point we have found a great dearth of theoretical treatment, and in most cases arising in our own experience have had to go to the bottom of the matter by fundamental original treatment, regardless of the books.

Had the the second part of Volume II. been published two or three years ago we should have saved ourselves very much labor in our laboratory work. This remark applies especially to the first portion of the book. Nowhere is there published so good a collection of recent methods for determining by laboratory processes coefficients of self and mutual induction, and comparisons with capacity. In fact, a great deal of this matter we had already been compelled to glean from various sources and put in mimeograph sheets before our students for laboratory use. The discussion of the principles involved in these determinations is particularly full and clear, and in our opinion no

work is better to train a student in careful manipulation, and in thorough understanding of electrical principles than these chapters of Dr. Gray on the measurement of inductances. For the mere practical work of finding inductances where they must necessarily be known for commercial reasons, and known for definite periods of current change as well, alternating current methods are doubtless the best. Mr. Steinmetz, among others, has given us simple methods, leaving but little to be desired; but as stated, for laboratory training in steady current methods and principles, it will be hard to surpass these sections of the second part of Gray's volume two. To those not having access to, or not caring to consult, the original papers, the rest of this second part will be very valuable, for it gives in detail the experimental determinations of the ohm and other units in absolute measure as given by Rowland, Lorenz, Thomson and others. There is a good account of all the methods, showing in full the experimental methods adopted, and the theories of the methods. A very full account is given of Sir William Thomson's standard balances and the mode of calibrating them, of the Rayleigh form of Clark's standard cell (we are sorry to find no account of Carhart's form of this cell, which we know by extended use to be an excellent and durable one, and we think more stress ought to be laid on the necessary constancy of the battery used in supplying the current for Rayleigh's experiment), of the best forms of galvanometers and their calibration by electrolysis, of magnetic induction, alternating currents, and finally of electrical oscillations, induction, and the experiments of Hertz.

It may be claimed by many that in a treatise devoted expressly to measurements in electricity and magnetism, so much theoretical matter shou'd not have place; but many years' experience as a laboratory instructor in electricity and magnetism leads us to a contrary conclusion. It is almost impossible to get some students to give theoretical matters their proper attention, especially when of a mathematical character, unless in connection with some practical applications in which they can be interested and can understand. We know how often this is true, even of maturer minds, and the full force of an abstract principle can sometimes only in this way be clearly apprehended.

We are glad to see Prof. John Perry's table of the first seven zonal harmonies appended, as well as a short discussion of their theory. This will greatly facilitate a better understanding of many of the most important parts of the work. We wish that a large use of this important treatise might be made by the advanced classes in our American colleges. It will fill a place which no other single treatise can. JOHN E. DAVIES.

PERSONAL.

J. H. Carson, president of the Sterling Car Heating & Lighting company, New York, has been in Chicago for several days. Mr. Carson is introducing street railway supplies of all kinds in the West, and reports that much interest is aroused in the new type of Sterling fare registers used quite extensively in the East.

P. H. W. Smith, formerly of the Field Engineering company, Buffalo, N. Y., has been appointed superintendent of construction of the western division of the Standard Underground Cable company. Mr. Smith, whose office will be located in the Rookery building, Chicago, has the advantage of a wide experience in his line of business, and is peculiarly well fitted for his position.

William W. Nugent, 823 Home Insurance building, Chicago, has been appointed western manager of C. & G. Cooper & Co., manufacturers of Corliss engines, Mt. Vernon, O. Mr. Nugent's extended and varied experience as engineer and agent of well known firms will doubtless be of great service to him and will enable him to give considerable prominence in this section to the name of his company.

L. H. Rogers, of Boston, has recently been appointed assistant general manager of the Brush Electric company, Cleveland. Mr. Rogers some years since was connected with the eastern offices of the Brush company. Subsequently he became connected with the General Electric company, of Boston. Mr. Rogers was also for some years connected with the Electric Accumulator company. He has had a large experience in the electrical business and will be a valuable officer for the Brush company. Mr. Rogers is well known as the originator and owner of the Mt. Washington search-light, which he placed on the summit of the mountain last summer. He has recently been experimenting with this search-light with a view of throwing intelligible words and characters long distances and he has succeeded in utilizing the clouds as a screen for this purpose.

NEW INCORPORATIONS.

Brott Electric Rapid Traosit Bicycle Railway company, Alexandria, Va ; capital stock, $300,000; to operate Brott bicycle railways.

Arverne & Rockaway Beach Electric company, Arverne-by-the-Sea, N. Y.; capital stock, $50,000; to manufacture and use electricity for light, heat and power.

Golden Gate Manufacturing company, New York, N. Y.; capital stock, $600,000; to manufacture and sell hardware, woodenware and electrical goods.

Electro Construction company of Virginia, Richmond, Va.; capital stock, $25,000; to construct and utilize electric and other machinery, heat power and light, etc.

Oshkosh Telephone & Electric Service Exchange, Oshkosh, Wis.; capital, stock $50,000; constructing and equipping a telephone system; Hume & Oellerich, Oshkosh, Wis.

Indianapolis & Martinsville Electric Railway company, Indianapolis, Ind.; capital stock, $50,000; constructing, owning and maintaining a railroad commencing at Indianapolis and running through Marion, Johnson and Morgan counties to Martinsville, Ind.; B. C. Stevenson, Indianapolis, Ind.

Milford Light & Power company, Milford, N. H.; capital stock, $80,000; to generate light and power with electricity in Milford and vicinity; R. N. Wallace, Milford, N. H.

Las Vegas Light & Fuel company, East Las Vegas, N. M.; capital stock, $100,000; to generate and sell electricity and to manufacture and sell gas; E. D. Bullard, East Las Vegas, N. M.

Indiana Electric Power company, Goshen, Ind ; capital stock, $300,000; to construct, maintain and operate electric street railways and to furnish power for same and other purposes; Lew Wanner, Goshen, Ind.

Crouch Electric Supply company, Portland, Ore.; capital stock, $100,000; to manufacture, build, own, buy, lease or sell electric machinery, appliances and equipments; S. L. Lovell, Portland, Ore.

Woodbridge & Sewaren Electric Street Railway company, Woodbridge, N. J.; capital stock $50.000; building, constructing, equipping, operating, running, managing and maintaining a street railway.

Electric Steam Generating & Power company (incorporated in W. Va.), 29 Broadway, New York, N. Y.; capital stock, $500,000; generating steam by electricity, etc.; Woodward & Mayer, New York, N. Y.

Copenhagen Automatic Fire Alarm company, Chicago, Ill.; capital stock, $50,000; to manufacture and sell thermostatic devices and electrical machinery, supplies and devices; Ross & Todd, 185 Dearborn street, Chicago, Ill.

American Fuel Economizer & Engineering company, Jersey City, N. J.; capital stock, $30,000; to manufacture and sell electrical appliances for economizing fuel and other machanical contrivances, etc.; Wilson & Wallace, 48 Wall street, New York, N. Y.

Electric Manufacturing company, Charleston, W. Va.; capital stock, $10,000; to manufacture electrical and surgical instruments and other appliances to operate telegraph and telephone lines, e c ; Lionel J. Noah, 18 Broadway, New York, N. Y.

Madisonville & Cincinnati Street Railway company, Madisonville, O.; capital stock. $100,000; constructing and operating street railways in Cincinnati and Madisonville, to be operated by electric or other motive power; Burch & Johnson, Cincinnati, O.

Cleveland Electric Railway company, Cleveland, O., capital stock, $12,000 000; consolidation of the Cleveland Electric Railway company, the Brooklyn Street Railroad company and the South- Side Street Railroad company; Squire, Sanders & Dempsey, Cleveland, O.

South Waukegan Electric Railway company, Shields, Ill ; capital stock, $100,000; to construct and operate electric street railways in the townships of Shields and Waukegan, Lake county, Ill.; Morris, Ganse & Craig, 1302 Chamber of Commerce, Chicago, Ill.

General Construction company of Illinois, Chicago, Ill.; capital stock, $300,000; constructing railways, water ways and works, canals, light, heat and power plant, railway and street car; doing all kind of public and private improvements; Aldrich, Payne & Defrees, Home Insurance building, Chicago, Ill.

ELECTRIC LIGHTING.

An electric light plant is being put in at Trenton, Tenn.

Flandreau, Dak., will put in an electric lighting plant during the coming summer.

The question of lighting the streets of Little Valley, N. Y., with electricity is being agitated.

Bonds to the amount of $50,000 will be issued by the town of North Attleboro, Mass , to pay for the erection of an electric lighting plant.

The Hyattsville Electric Light, Heat & Power company has been organized to put in an incandescent electric light plant at Hyattsville, Md.

Toronto, Ont., has sold its electric light plant, and hereafter the city will be illuminated by the Toronto Incandescent Light company.

It is said that during the last four years there have been installed in Louisville, Ky., some sixty or seventy isolated incandescent electric light plants.

The Water Works & Gas company of London, O., will ask for a right of way to erect poles on the streets with a view of lighting the city with electricity.

The authorities of New London, O., have awarded the contract for an electric light plant in that place to the Howe Construction company of Newark, O.

H. R. Leavens, T. S. Coolidge, M. O. Brown and E. B. and O. S. Potter, of Glens Falls, N. Y., are projecting a scheme to build a dam across the Hudson River 30 feet high, put in an electric plant, and supply the villages of Glens Falls, Sandy Hill, Fort Edward, Gansevoort, Fort Ann, Saratoga and other neighboring places with electricity for power and lighting.

ELECTRIC RAILWAYS.

An electric line is proposed to connect Santa Barbara and Montecito, Cal.

The city council of Columbus, O., has granted permission to the Columbus Street Railway company to extend its tracks on Naghten street, from Cleveland avenue to Neil street.

An Electric Railway between Red Bank and Long Branch, N. J., is contemplated.

The right of way for an electric line in North Alton, Ill., has been granted by the council.

The construction of an electric railway between Toledo and Maumee, O., is contemplated.

A street railway to connect the public square, depots and fair grounds of Bloomfield, Ia , is projected.

The Pacific Railway company of Los Angeles, Cal., has asked to be allowed to operate its road by electricity.

The Owego, N. Y., Electric Railway company, contemplates the construction of an electric railway to Hiawatha Island.

A company composed of New York capitalists has been granted a franchise for an electric street railway in Hagerstown, Md.

The Barnes Heights and Cornell Mountain electric road, Portland, Ore., is now in successful operation. It is three miles long.

The Wakefield & Stoneham Street Railway company, Wakefield, Mass., proposes to extend its lines and equip them with electricity

The Bay City, Mich., Consolidated Street Railway company will extend and improve its lines, having issued $500,000 in bonds for that purpose.

The electric railroad between Buffalo and Williamsville, N. Y., which has been in the process of construction for some time, was formally opened April 4th.

The Phœnix Electric Street Railway company, of Phœnix, Ariz., is to extend its tracks one and one-half miles. The foundation has been laid for a power plant.

The Wiston Electric company of South Milwaukee, Wis., has secured a franchise for erecting an electric light plant in South Milwaukee, the cost of which will be $25,000.

John Cross is asking the city council of Pasadena, Cal., for a franchise over the streets, and contemplates building an electric street railway between Los Angeles and Pasadena.

The Capital electric railway, of Baton Rouge, La., was opened to the public April 5th with appropriate ceremonies, including the driving of a silver spike by President B. F. Mayer.

President Kilgour, of the Consolidated company, Cincinnati, O., says that the company will put on two hundred open cars this summer and change existing horse lines to electric.

The Buffalo & Niagara Falls Electric Railway company, Buffalo, N. Y. (capital stock, $1,000,000), has been incorporated to construct a street surface railroad to be operated by electricity.

The Indiana Electric Power company has been granted a franchise for building and operating an electric street railway in Goshen, Ind. The company will run independent lines to Elkhart, ten miles distant.

Efforts are being made by the Thomson-Houston company, through legal proceedings, to obtain possession of the electrical equipment of the San Francisco & San Mateo electric railway, San Francisco, Cal.

The Millville, N. J., Street Railway company have been formed with a capital stock of $20,000, to build a trolley line two miles long in Millville, and as soon as possible to extend it to Brighton, ten miles distant.

The City Park Railway company, Denver, Colo., has been granted the right of way on several streets of the city to construct and operate a street railway with electricity, gas or compressed air as the motive power.

The Phœnix Electric Light & Power company has bought the plant of the Electric Light company of Los Angeles, Cal. A number of additions will be made at once to the plant, a new 1,000-light dynamo and two large new boilers have been placed, and provision made for arc lights and also power for electric fans and machinery.

TELEGRAPH.

It seems probable that telephonic connection across the sound between Malmo on the Swedish and Copenhagen on the Danish coast will soon be an accomplished fact. As Malmo is already in telephonic connection with a number of places in Western Sweden, and with all of the state telephones and Stockholm, this new international line should prove of great practical importance. Experiments have shown that an already existing reverse cable across the sound, jointly owned by Denmark and Sweden, will answer the purpose, and that its connection with the state telephonic system in Sweden is sufficient to ensure a perfectly efficient telephonic connection between the Swedish and Danish capitals.

MISCELLANEOUS.

W. F. Fife is interested in an electric smelting plant proposed for Tacoma, Wash.

The Edison Electric company of New Orleans, La., has been incorporated with a capital stock of $500,000.

The Folsom Electric Light & Power company will erect a long distance power transmission plant from Folsom to Sacramento, Cal.

The West Michigan Electric company has commenced

work on the dams of the water power at Lowell, Mich., which are to be used for transmitting electric power, and which power it is proposed to retail in Grand Rapids for light, manufacturing and other purposes. The dams are to furnish 3 000 horse power, which will be generated through the medium of horizontal water wheels.

E. M. and W. Ferguson, owners of the Ferguson block, Third avenue, Pittsburg, Pa., have entered suit to recover $7,798 96 from the Edison General Electric company. The defendants contracted in 1891 to fit up the new building with engines, dynamos, etc., at a contract price of $7,900, on which they paid down $5,530. In addition it cost over $2,000 to prepare the building for the work. It is alleged that the work is not satisfactory; that it was not done according to contract, and that it will have to be taken out.

TRADE NEWS.

C. E. Lee, who has been well known for some time as the Chicago representative of the Electric Gas Lighting company, has removed to 65 Lees building, 149 Fifth avenue, Chicago, where he will continue to carry in stock the Samson battery as well as other fine specialties.

The Bridgeport Machine Tool Works, Bridgeport, Conn., is making a specialty of its boring and turning mills. This company has recently enlarged its works and added many special tools and fixtures for making and handling heavy machines and is now fully equipped to meet the demands made upon it.

Taylor, Goodhue & Ames, manufacturers and dealers in electrical material, have just moved into their new store, 548 Dearborn street, Chicago. This firm has earned a well deserved reputation from its Century line wire and insulating materials in which it is an extensive dealer. Patrons of the firm will wish it continued success in its new home.

The Electric Appliance company, Chicago, is selling agent for the "O. K." wire, manufactured by the Phillips Insulated Wire company, New York. The Appliance company has lately received a number of fine reels of this brand of wire and intends to make it a special feature among its exhibits at the World's Fair. The factory of the Phillips Insulated Wire company is situated at Pawtucket, R. I.

Clark & Marshall, dealers in electrical specialties, may now be found in their new quarters, room 413 Rookery, Chicago, where they will show their new specialties in the line of fan motors for direct and battery circuits, storage batteries, consolidated knife switches, flexible brackets, etc. The firm opens this office for the convenience of its friends and patrons in the city during the World's Fair.

The J. T. Case Engine company of New Britain, Conn., manufacturer of the well known and improved Case automatic high speed engine, has recently issued an illustrated catalogue describing its machine, which will be of much interest to the trade. Simplicity and compactness are the points aimed at, and those who have a knowledge of the engine can testify that these merits have been attained. It is of a type of construction permitting of the adoption of the fewest working parts, and these of the lightest weight, resulting in the accomplishment of high speed without injurious vibration.

The Ansonia Electric company, formerly the Electrical Supply company, Chicago, continues to receive orders for its Shield brand moisture proof line wire. It reports the sales of last week to have been among the largest since it has handled the wire. This company will soon be in better condition than ever to supply the Wirt indicators and the standardized fuse links, as all testing, calibrating, etc., is now to be done at the new Wirt laboratory. So satisfactory have been the sales of the Wirt indicator that the Ansonia company intends making a special exhibit of them at the World's Fair. Orders for several 1,800 ampere indicators have been recently received.

Among dry batteries perhaps there is none better or more favorably known than the Ajax. Four years ago this battery was placed on the market and continual improvements have been made upon it until the exclusive agent, the Ansonia Electric company, Chicago, formerly the Electrical Supply company, claims it to be the leading dry battery in the country to-day. It still wears the familiar red jacket with a cut of Ajax defying the lightning. This firm has recently turned out a colossal Ajax battery for exhibition at the World's Fair, which will give a current of six volts and seven amperes. Its dimensions are 30 inches high by 12 inches in diameter and it no doubt will attract considerable attention in the electrical building.

In completeness of detail and compactness of matter, the new illustrated catalogue and price list just issued by the Electric Gas Lighting company, 195 Devonshire street, Boston, Mass., can hardly be excelled. The book is artistic as well as complete and bears the evidence of careful and thorough preparation. This company has achieved an enviable reputation for the excellence of its electrical apparatus, and a short time spent in examining its latest catalogue will give an idea of the variety of its specialties. Full directions are embodied with the cuts and description of instruments for placing them in proper position for use and explaining their care. Batteries and battery supplies, wires, cables, telegraph instruments, motors, electrical tools, push buttons, induction coils, cut outs—all are fully treated and illustrated in a manner that attracts consideration and demands attention. One particular feature of the stock is the electro-medical instrument assortment comprising the Crown Faradic battery, medical induction coils and a number of batteries especially designed for the medical fraternity.

BUSINESS.

The Chicago office of the Phœnix Iron Works company has been moved from 418 Chamber of Commerce to 519 Rookery.

The Ansonia Electric company, formerly the Electrical Supply company, Chicago, has secured the contract for the overhead equipment for 10 miles of road for the Miami Valley electric railway, running from Piqua to Troy, O.

The Commercial Electric company, of Indianapolis through its Chicago office, 455 Rookery building, has just installed a 15 horse power motor in the establishment of the Vienna Bakery company, west side, Chicago. This sale was made in the face of strong competition and it is needless to say, is a good indication of the excellence of the Commercial machine. This company has also just placed a 20 horse power motor in Chicago through the Ansonia Electric company.

H. W. Knight & Son, of Seneca Falls, N. Y., have made pattern letters and figures for thirty years, and their long experience gives them a firm hold on the trade, and enables them to lead in their line. All their letters are cast, and finished by hand. They constantly have on hand 2,000,000 letters and figures in their stock. Of some of the smaller sizes of which there is a large demand, they have 30,000 finished and ready to ship. This enables them to fill all orders the same day received. Some of their hair-line letters are so small that it takes 10,000 to weigh a pound, while others weigh 20 pounds each. They have agencies established all over the United States, also in Europe. Address them for their catalogue, drawer 1256.

Electrical manufacturers will find the exhibit of the Eureka Tempered Copper company of North East, Pa., at the World's Fair especially interesting. This concern has spared no expense to illustrate through its exhibit the great progress it has made in the production of tempered copper. The company's booth is situated in the electricity building, second floor, section U, No. 14. It is a few feet to the left of the southwest entrance. The interior of the booth is fitted up with hardwood cases lined with black velvet, in which are displayed samples of the company's copper. Case "A" will contain samples of the Eureka rolled tempered copper that have been made into motor brushes for all systems; case "B" will contain a representative line of miscellaneous articles and novelties made by the company. In cases "C" and "D" will be found finished commutator segments of pure tempered copper for almost every system; case "E" is filled with a fine lot of ring castings that may be cut into segments for the Brush, Western and Thomson-Houston systems; case "F" contains street railway trolleys for nearly all systems, and also a fine collection of soldering irons and cast bars; case "G" is filled with bare and insulated wires; and case "H" contains commutator heads and bearings of various kinds. There will be, too, an exhibit of castings for surgical instruments, etc., and two long tables filled with commutator heads. At the entrance to the booth are two commutators made for the Westinghouse system that weigh 1,000 pounds each; in fact it is interesting to note in this connection that every current for either light or power purposes furnished under the Westinghouse contract with the exposition comes from commutator segments of Eureka tempered copper. The booth which will contain the elaborate exhibit of the Eureka Tempered Copper company was the first one in the electricity building to be completed. This was due to the energy and zeal of the company, which has done all in its power to make the exhibit one of the handsomest in the building. The company's Chicago office, at 407 Rookery building, is in charge of W. H. Grissom.

ELECTRICAL PATENTS.

Issued April 25, 1893.

495,996. Closed Conduit Electric Railway. William P. Patton, New York, N. Y.

496,019 Electric Soldering. Elihu Thomson, Lynn, Mass.

The invention is designed to overcome the difficulty experienced in soldering long seams, due to the fact that the cooling takes place unequally; and, at the moment the solder sets parts of the seam contract and draw, thus breaking the joint. The pieces to be soldered are clamped together at the seam or joint, and an electric current is then passed through the pieces to be joined, and in sufficient volume to melt the solder or uniting material, after which the current is cut off, but the clamping pressure maintained until the joint cools.

496,020. System of Electric Distribution. Elihu Thomson, Swampscott, Mass.

496,041. Electro-mechanical Block Signaling Apparatus. Murray Corrington, New York, N. Y.

496,069. Electrical Stop Motion for Knitting Machines. George J. Manderfield, Royersford, Pa.

496,067. Electric Alarm for Tanks. Frederic C. Skelton, Montreal, Can.

496,076. Signaling Apparatus. Hermann Wetzer, Pfronten, Germany.

496,081. Insulator. Joseph F. Wright, Colorado Springs, Colo.

496,103. Electric Cigar Lighter. Lawrence T. Smith, Barrington, R. I.

496,104. Lineman's Wire Grip. Claes A. Svensson, Buffalo, N. Y.

496,126. Storage Battery. Frederick A. La Roche, Philadelphia, Pa.

A porous partition is placed between the positive and negative electrodes of the cell and the cell hermetically sealed, the partition permitting the passage of liquid below the surface of the liquid, but having its pores above the surface line filled, or otherwise treated, so that the evolved gases may not pass through the partition. Thus, in charging the battery, the gas evolved from the positive pole will be confined in the chamber between the surface of the liquid and the top of the cell, while the gas evolved from the negative pole will be likewise confined in a chamber, the chambers being distinct and non-communicating. By thus collecting the gases which are evolved at the poles and keeping them in electrical connection with the poles at which they are evolved, the work done in evolving them, it is found, can be largely returned in the discharge of the battery. It has been found that each cell has thus a greater electromotive force and a greater capacity when charged.

496,134. Electric Synchronizer for Clocks. Henry S. Prentiss, Elizabeth, N. J.

496,135. Electric Synchronizer for Clocks. Henry S. Prentiss, Elizabeth, N. J.

496,137. Mechanical Telephone. George H. E. Ricke, Cincinnati, O.

496,191. Phonograph. Thomas A. Edison, Llewellyn Park, N. J.

496,192. Annunciator. John H. Elfering, Milford, Conn.

496,207. Electric Reporter. Major D. Porter, Brooklyn, N. Y.

496,208. Process of and Apparatus for Tempering or Hardening Steel Wire. Henry E. Procunier, Oak Park, Ill.

496 212. Electric Converter. William Stanley, jr., Great Barrington, Mass.

496,224. Diaphragm Holder for Telephones. Silas W. Holman, Boston, Mass.

The diaphragm, instead of being rigidly secured or clamped at some or all points around its periphery, is supported between two rings of different diameters, the action of the two rings serving to deflect the center of the diaphram in one direction. The electro-magnet is so mounted that in acting upon the diaphragm it opposes this tendency of deflection, caused by the rings of different diameter.

496,258. Electric Programme Clock. Henry C. Hain, Booneville, Mo.

496,307. Combined Dynamo-electric Machine and Water Motor. John O. Heinze, jr., Lynn, Mass.

496,308. Cut-out and Circuit Protector. John O. Heinze, jr., Lynn, Mass.

496,309. Volt and Ampere Meter. John O. Heinze, jr., Lynn, Mass.

496,312. Electric Measuring Instrument. Rudolph M. Hunter, Philadelphia, Pa.

The measuring instrument is of the type in which the movement of the index is effected by the expansion of a wire included in circuit with the current to be measured. Besides the expansible wire a compensating wire is provided which is not included in the electric circuit, but which is so connected with the expansible wire that any change of temperature due to external influences, as the weather, will be compensated for.

496,324. Coin Controlled Automaton. Harry D. Pursell and Edwin F. Price, Washington Court House, O.

496,329. Telpher System. Charles J. Van Depoele, Lynn, Mass.

The track comprises four rails running parallel and placed one upon each of the four sides of the car, which is provided with wheels adapted to engage with the various rails. The lower rail serves to support the greater part of the weight of the car, the rail above and those at the sides serving to maintain the car in a vertical position. The rails are joined together by strong metallic yokes or frames which are mounted upon supports.

496,330. Electric Locomotive. Charles J. Van Depoele, Lynn, Mass.

496,331. Electro-magnetic Reciprocating Pump. Charles J. Van Depoele, Lynn, Mass.

The pump comprises a solenoid provided with a core adapted to be moved vertically by changing the polarity of the solenoid. To the lower end of the core is attached the piston of the pump, which, during the upward stroke of the core, raises the water from the reservoir by suction; and which, during the descent of the core, forces the water upward. The core possesses considerable weight, so that advantage may be taken of the work yielded by its descent, the greatest amount of energy being desirable at this time, as the forcing action of the pump is then taking place.

496,366. Electric Light Display System. Daniel McF. Moore and Charles M. Jacobs, New York, N. Y.

496,371. Electric Meter. Francis Teague, London, Eng., assignor.

496,373. Matrix Making Machine. Charles L. Travis, Minneapolis, Minn.

496,381. Cable Rack. Albert C. Gray, Pittsburg, Pa.

Vertical rods or tubes are supported between transverse beams at the top and bottom of a multiple switch-board for telephone exchanges. To the vertical rods are journaled brackets, which are provided with axial openings through which set-screws pass, by means of which the brackets may be clamped to the vertical rods at any height. By means of the axial set-screws the position of the bracket may be altered without removing the cables carried on it.

496,382. Controlling Device for Electric Elevators. Charles E. Moore, Boston, Mass.

496,386. Electric Arc Lamp. William H. Akester, London, Eng.

496,387. Electric Arc Lamp. William H. Akester, London, Eng.

The lower carbon is supported upon a vertical movable frame and a cord passes from this frame upward and over a pulley, and down again to the upper carbon, which is suspended from this downwardly extending portion. The upper carbon is somewhat heavier than the lower carbon, so that when the upper carbon is unclamped by the feeding mechanism, feeding takes place.

EUGENE F. PHILLIPS, Prest. W. A. HATHAWAY, Treas. W. H. SAWYER, Sec'y.

AMERICAN ELECTRICAL WORKS,

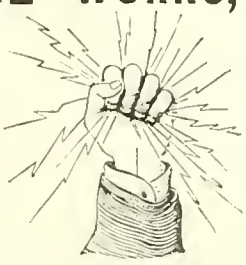
PROVIDENCE, R. I.

RAILWAY FEEDER AND TROLLEY WIRE,

ELECTRIC LIGHT LINE WIRE,

Incandescent and Flexible Cords,

AMERICANITE. MAGNET. OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



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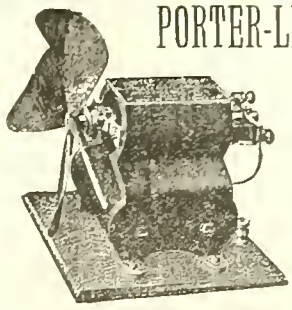

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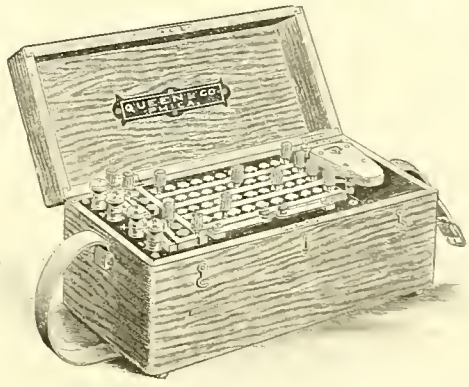

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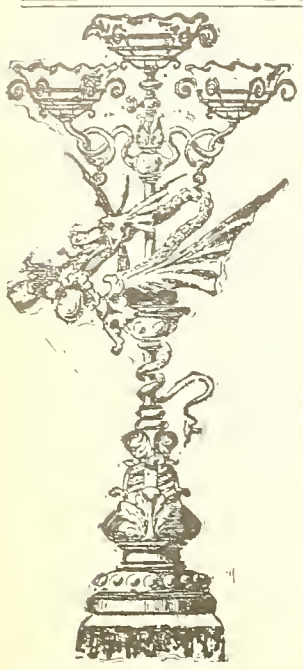

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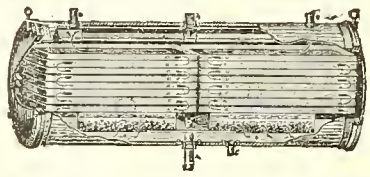

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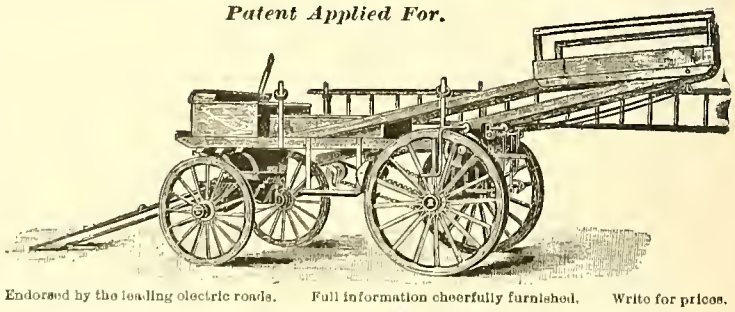

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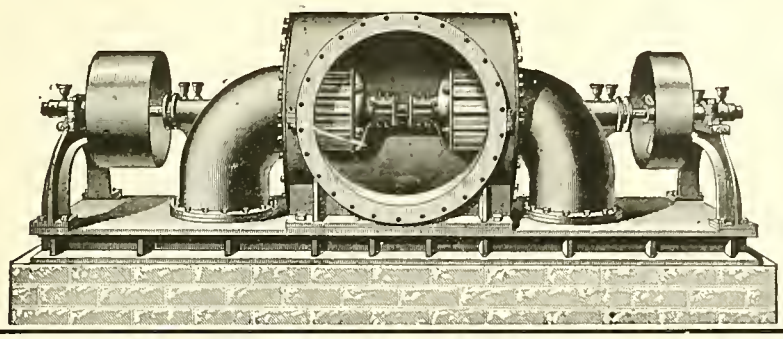

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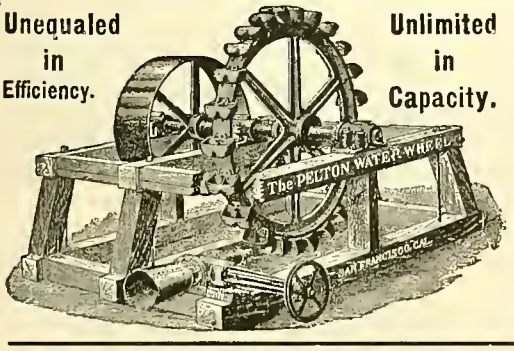

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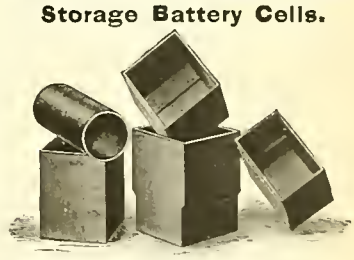

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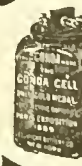

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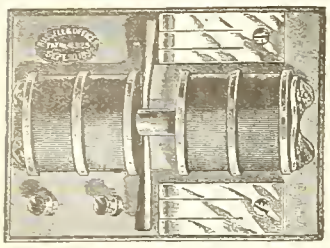

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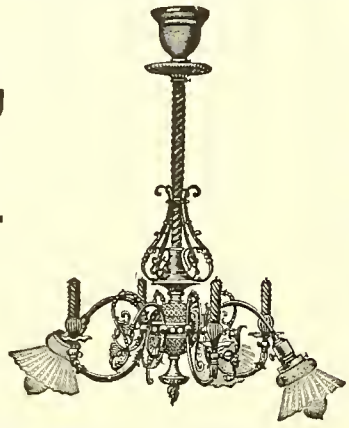

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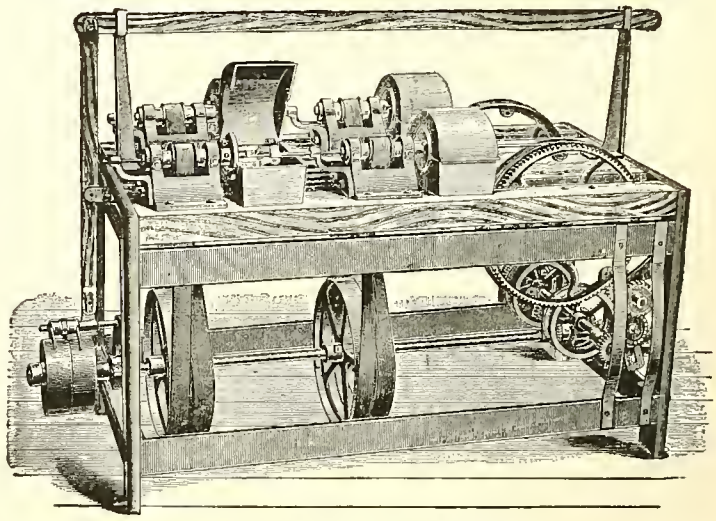

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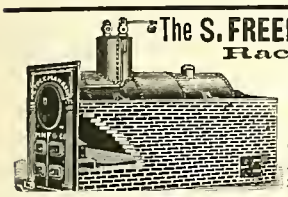

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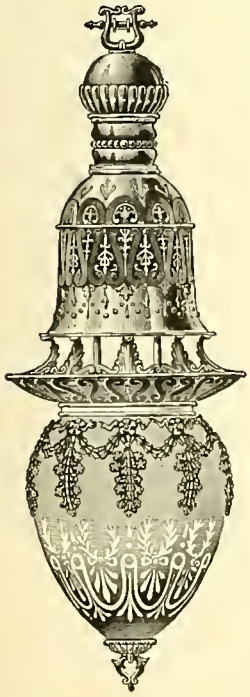

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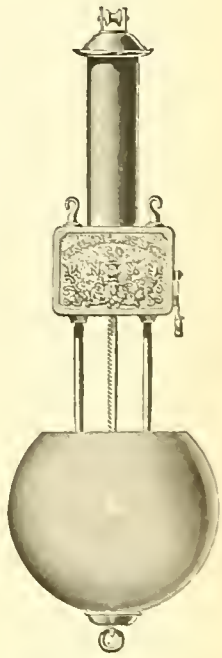

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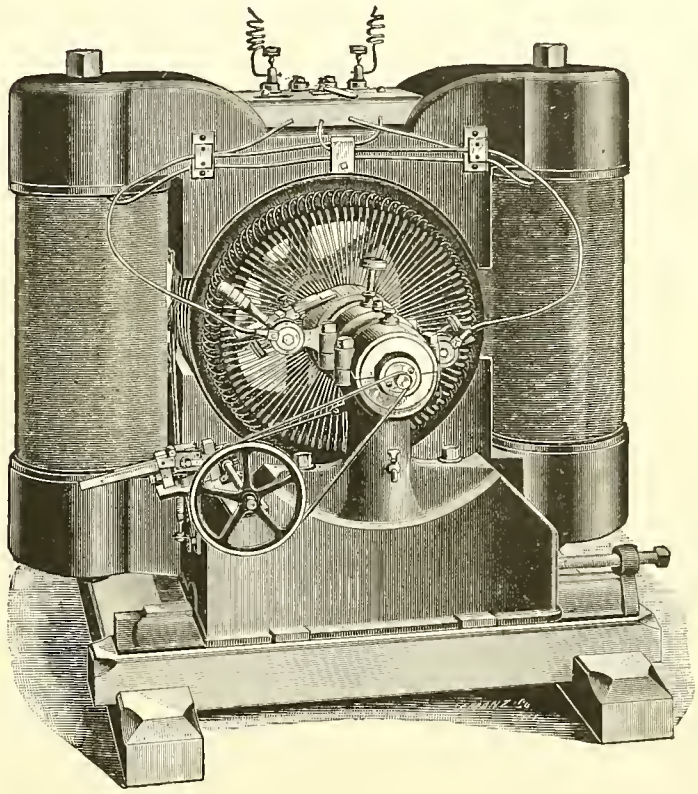

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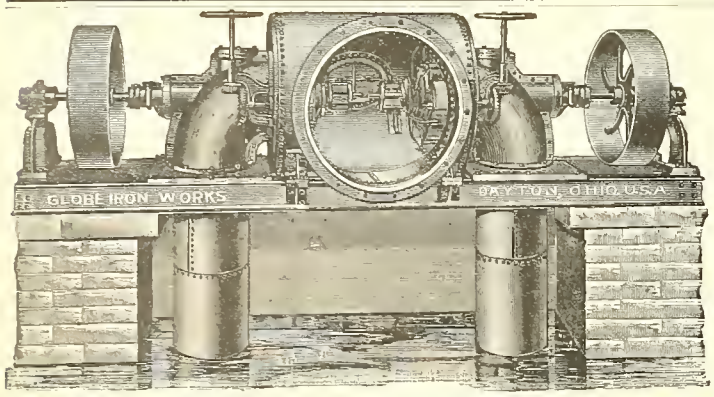

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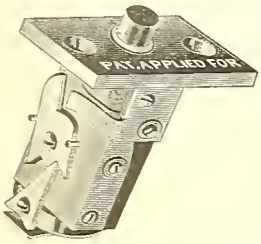

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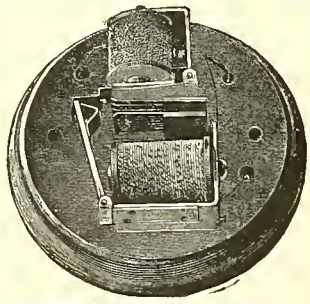

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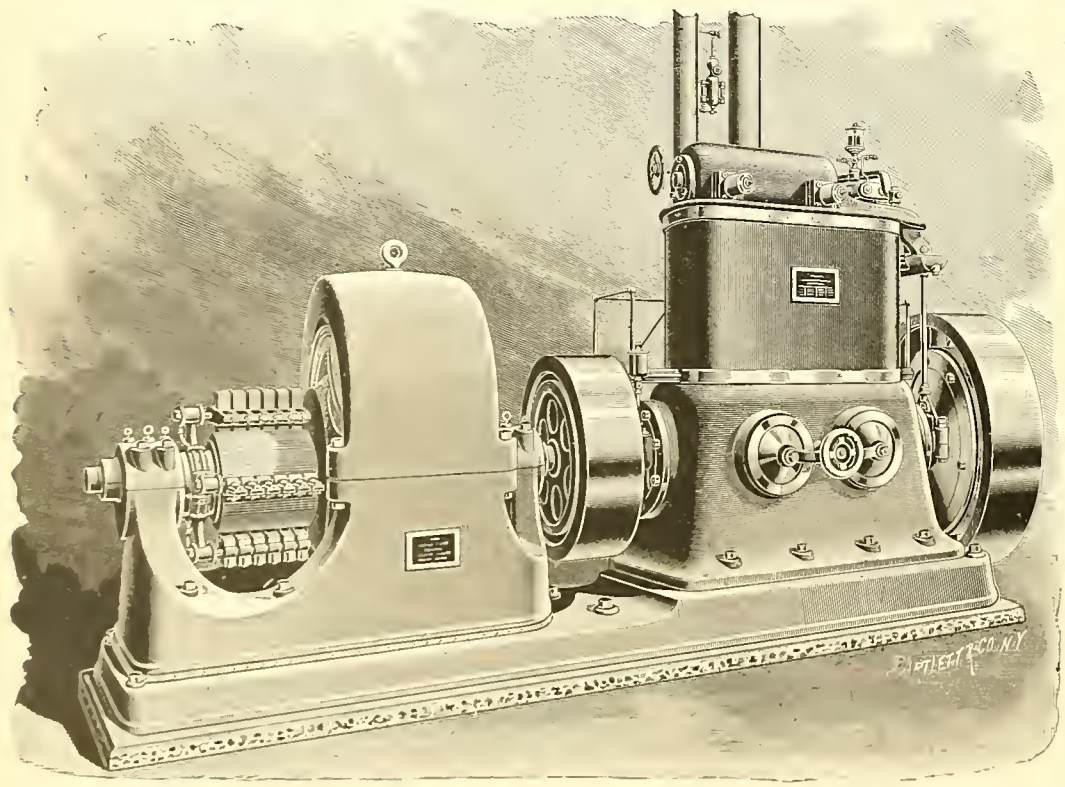

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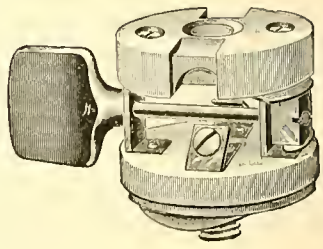

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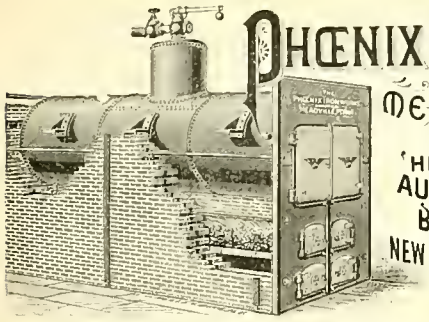

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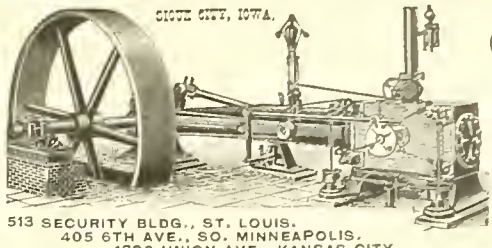
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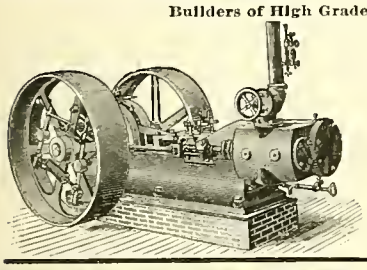
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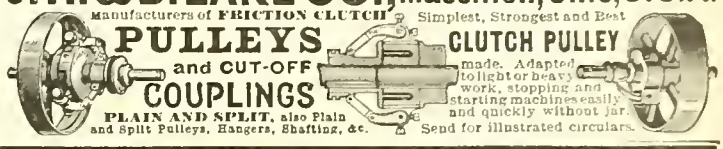
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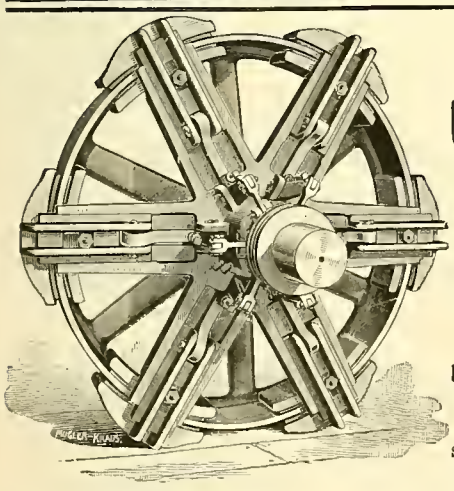
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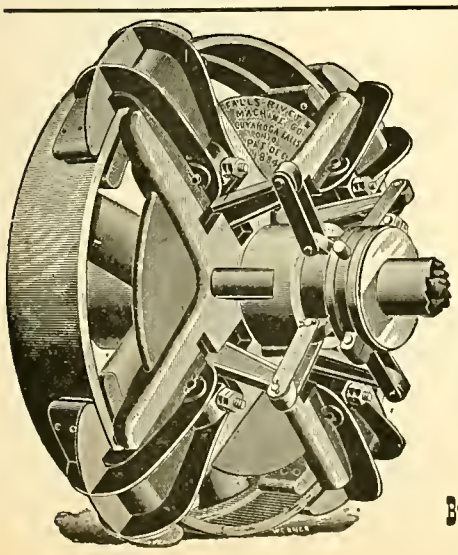
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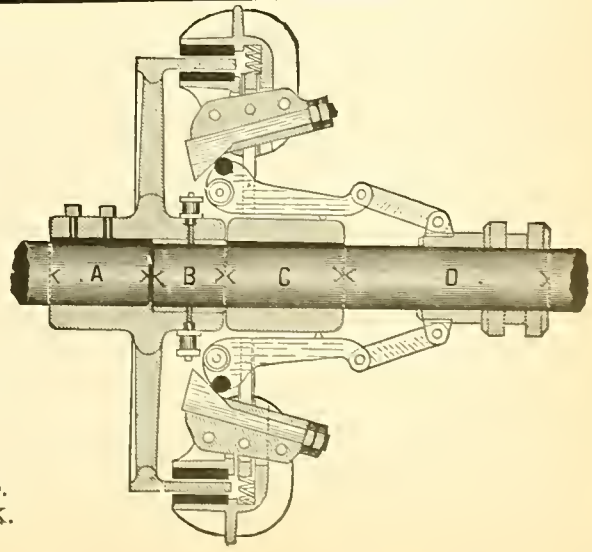

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6,000 MILES

OF ELECTRIC STREET RAILWAYS; OF THESE

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ARE OPERATED UNDER THE

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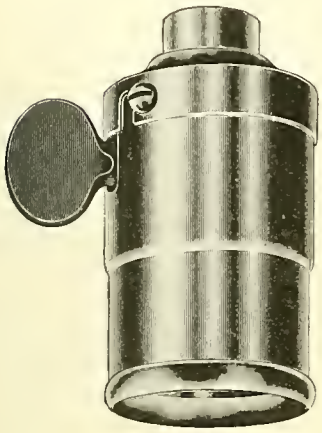

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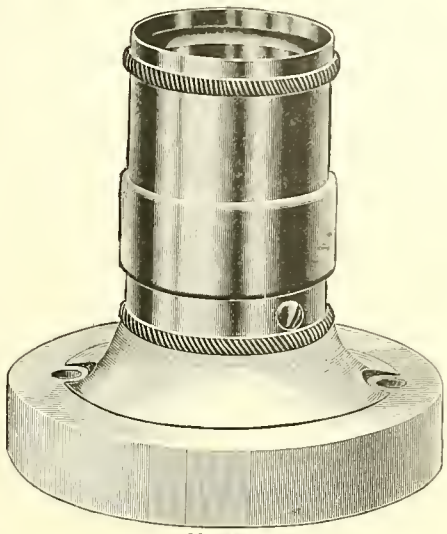

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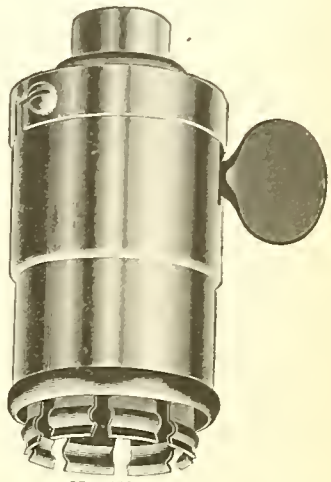

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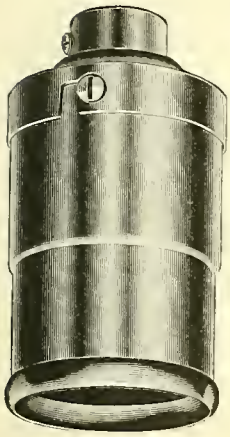

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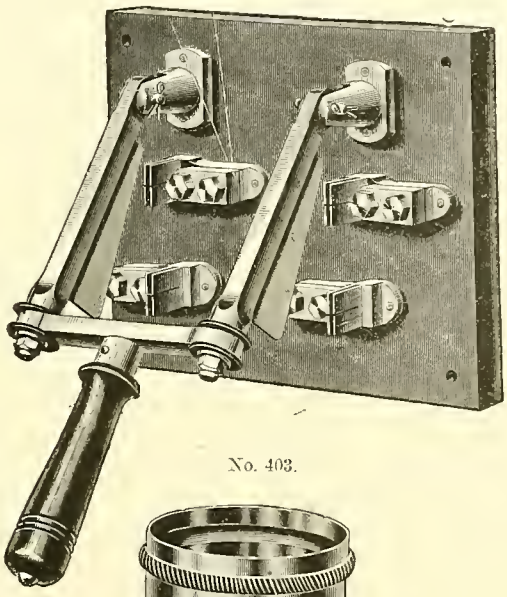

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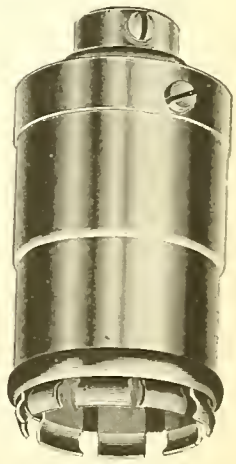

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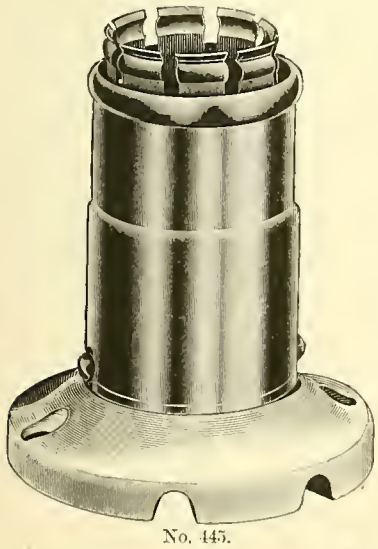

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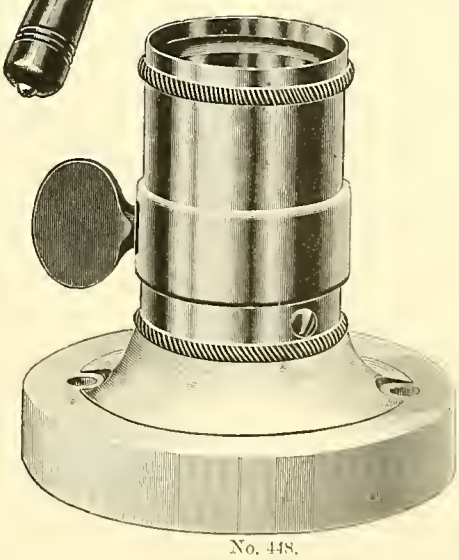

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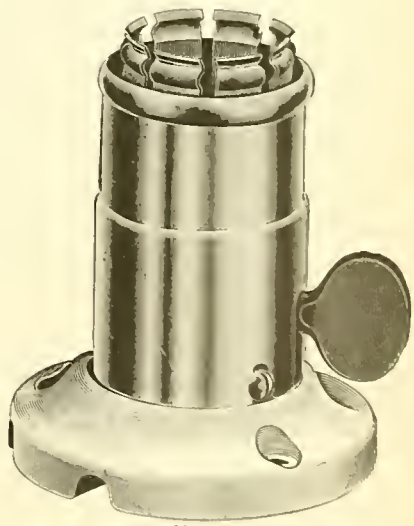

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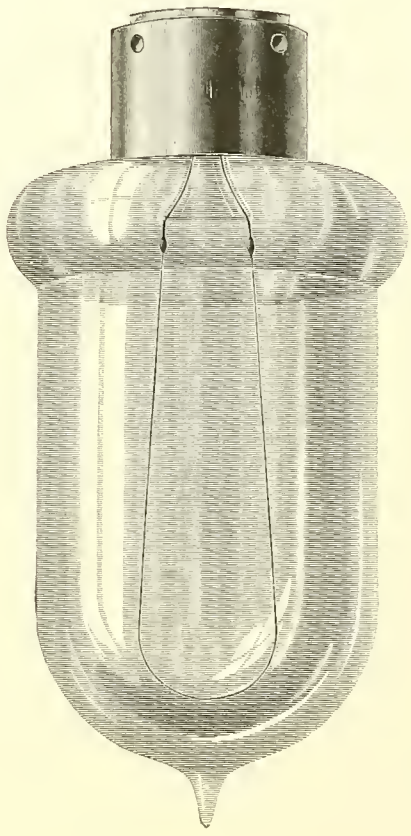
INCANDESCENT LAMP.



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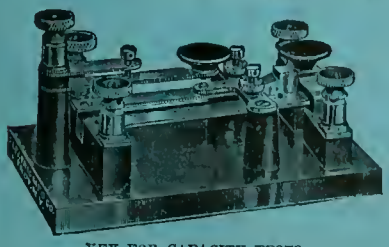

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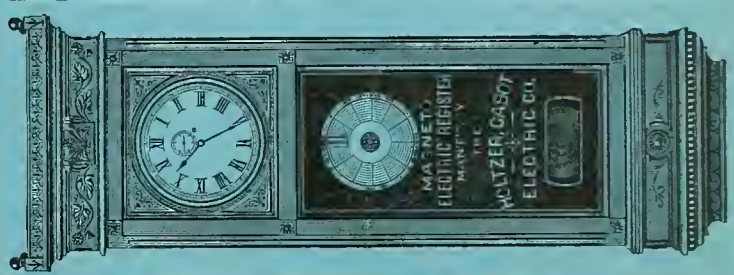

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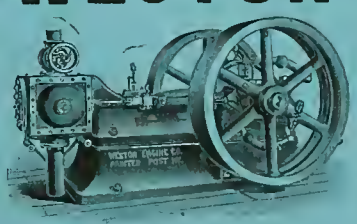

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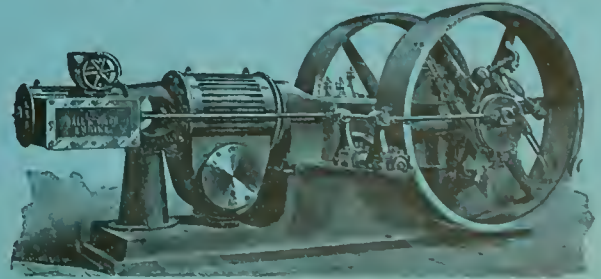

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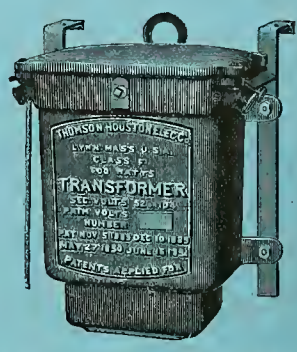

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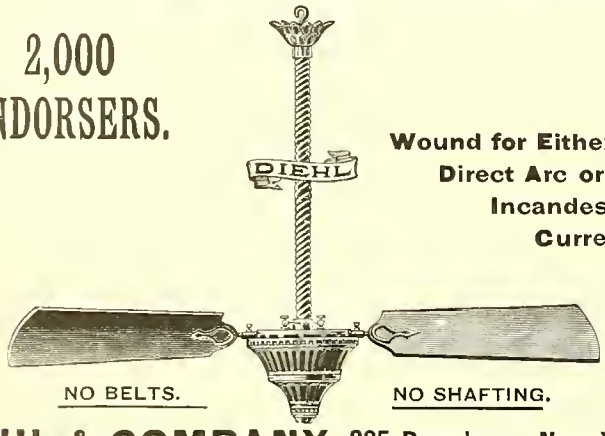

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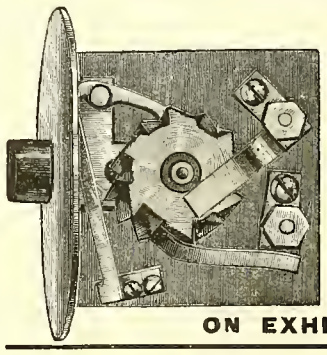

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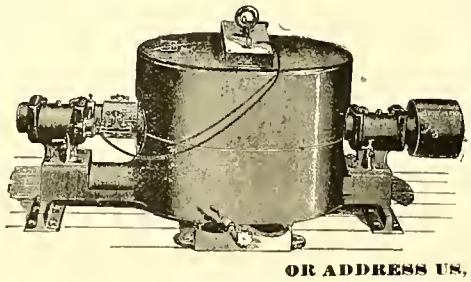

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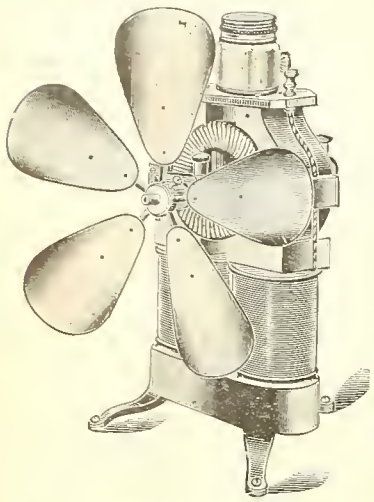

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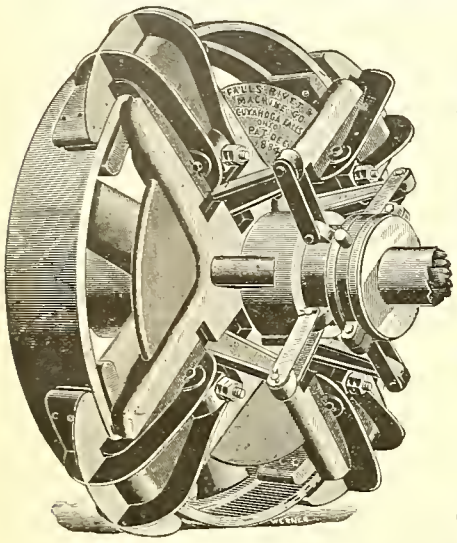

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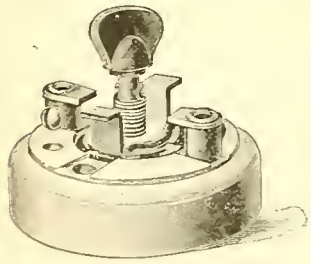

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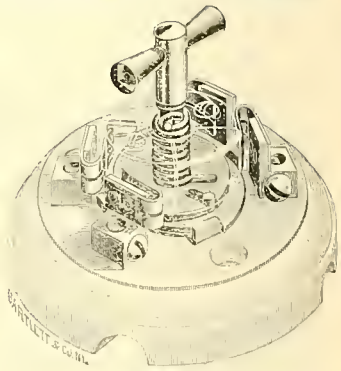

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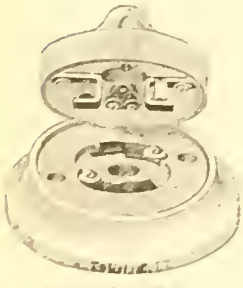

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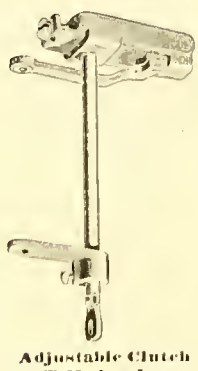

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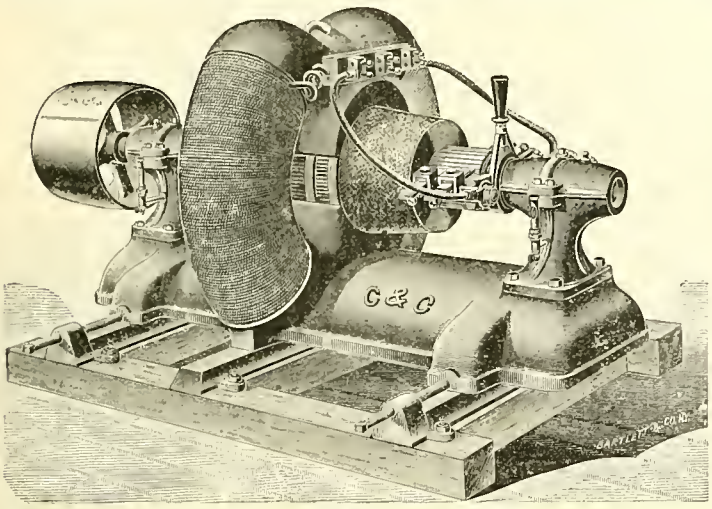

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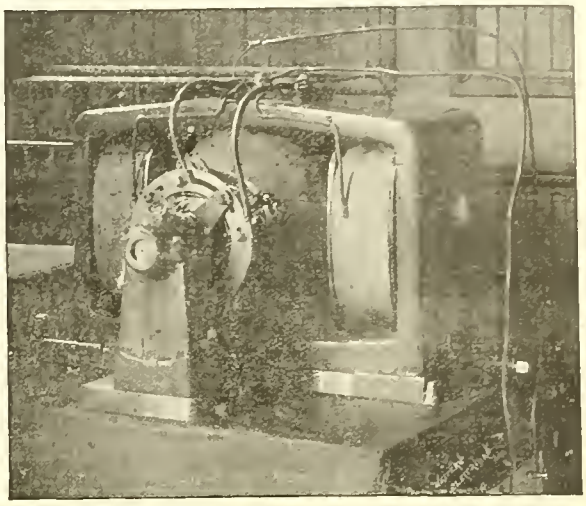

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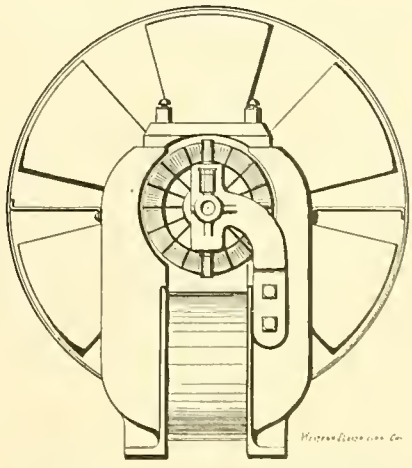

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OF ANY SIZE AND VOLTAGE.

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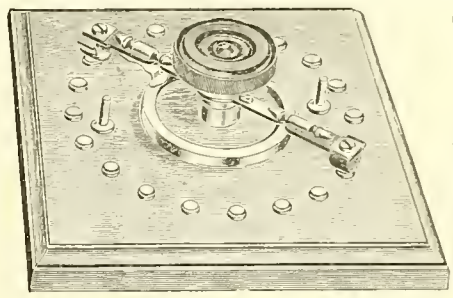

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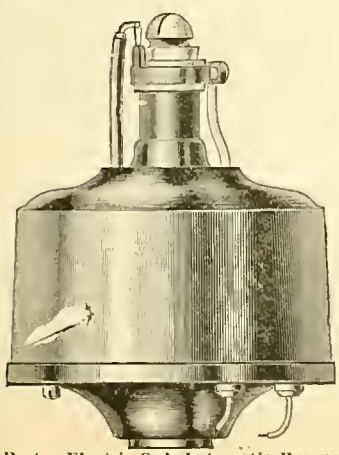
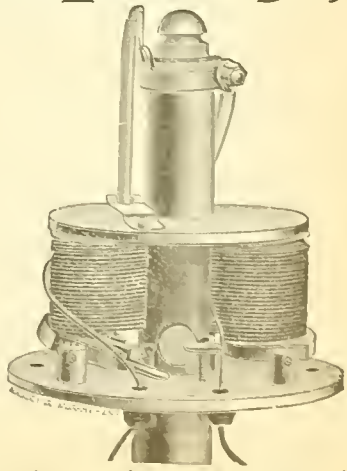
Buy burners made by the BOSTON ELECTRIC CO., and get the best. You will thereby save the profits of your labor, besides giving your customers perfect satisfaction.


Boston Electric Co.'s Automatic Burner.


Boston Electric Automatic Burner (shell removed.)

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Electrical Machinery.

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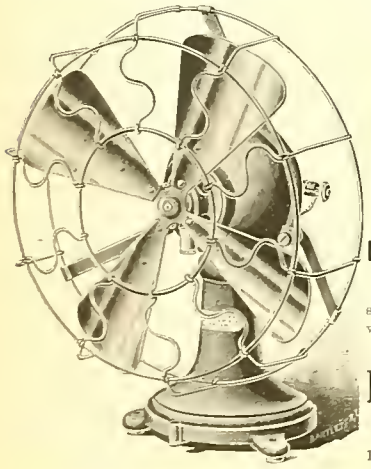

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PRICES.

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TWENTY PER CENT.

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About the Whitney Instrument for Alternating Current Work?
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GET POSTED.

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PRICES AWAY DOWN.

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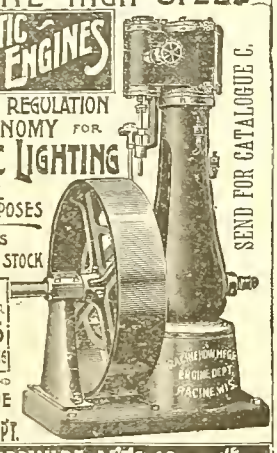

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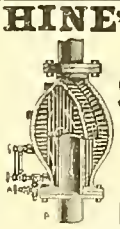

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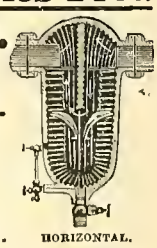

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The WADDELL-ENTZ COMPANY,

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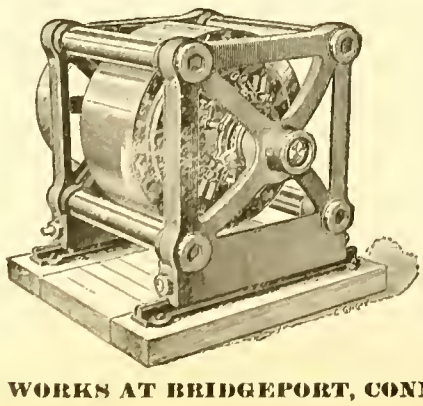

Improved Slow-Speed Generators and Motors. "DIRECT-DRIVEN" Slow-Speed Generators for Electric Lighting and Power. Low Running Expense. Insulated Wire and Flexible Cords. Estimates furnished. Isolated Plants a specialty.

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WORKS AT BRIDGEPORT, CONN.

Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, MAY 13, 1893. No. 19

How President Cleveland Opened the World's Fair by Electricity.

By Locke Etheridge.

Many ingenious theories have been brought forward to explain how President Cleveland actually set in motion the wheels of the Columbian Exposition on May 1st. Of course it was evident to the thousands present at the time that all he himself actually did was simply to press lightly on a highly ornamented telegraph key, but the mechanism by which the simple pressure of his finger set in motion many ponderous machines has never, as far as I am aware, been fully and truthfully explained.

In the first place, the whole system was an electrical one. From the president's key two wires led under the stand, back into the administration building, thence by underground duct to the great electric subway. The lines followed the subway into machinery hall and then split, one side running to the large 15,000,000 gallon Worthington pump in the pump-house, and the other running to the E. P. Allis & Co.'s engine block in machinery hall. A wire also connected the Worthington pump with the Allis engine, completing the circuit.

At the Allis engine was placed the engine starter made by the Electro Automatic Appliance company of Hartford, Conn. It consisted of a silver trimmed, polished oak case about 12 or 15 inches square, surmounted by a ten-inch, silver plated gong. Running through the case was a light shaft carrying a powerful spiral spring and a heavy hough small balance wheel. On the end of the shaft, outside the case, was a small sprocket wheel and chain, connected to another sprocket wheel secured on the stem of the throttle valve. The act of closing the engine valve wound up the spring, and it was secured in its state of tension by a small trigger. This trigger was controlled by the armature of a powerful electro-magnet, so that when the circuit was closed, with a magnet and a battery in circuit, the armature was attracted, the trigger released the balance wheel, and the stored energy of the coiled spring caused the shaft to revolve in the opposite direction to which it did when the throttle was closed. Thus, by the medium of the two sprocket wheels and the chain, the steam valve to the engine was opened. Connected in multiple with the electro magnets that controlled the trigger was another pair of coils, with a vibrating armature, to ring the gong on the outside of the case. An illustration of this device is presented in Fig. 3.

At the pump-house another system was in use. It was an electrically controlled valve, handsomely silver-plated, supported on a polished oak table, and furnished by the National Electric Valve company. In this case the armature of a powerful electro-magnet controlled the valve stem of a miniature steam chest, the movement of which allowed steam to enter on one side of a small piston and rod contained in a cylinder, the movement of the piston throwing the throttle of the pumps wide open.

The controling magnets of these two automatic engine starters, one in the pump-house and the other in machinery hall, were connected in series with six "Ajax" cells and twelve cells of "Perfected" dry battery, and were connected with a No. 14 B. & S. double and twisted insulated wire furnished by the Safety Insulated Wire company of New York. The metallic circuit led to the stand, where stood the golden Victor key, Fig. 2, on its standard of yellow and blue plush, ready for the touch of the presidential finger, as shown in Fig. 1.

The key itself is a very handsome piece of workmanship. It is of solid gold, with an ivory finger rest, and on the sides of the handsome plush standard were the dates 1492–1893. The key and standard were furnished by the E. S. Greeley & Co. of New York, through the World's Fair representative of the company, Mr. Auerbacher. The key on its pedestal will be on exhibition in the company's exhibit in the electricity building.

FIG. 1. HOW PRESIDENT CLEVELAND OPENED THE WORLD'S FAIR BY ELECTRICITY.—THE KEY AND STANDARD IN POSITION.

In starting the fountains it was found necessary that the pressure of water in the mains should be up to full pressure just as the key was touched, and as it was not practicable for this pressure to be kept up for any great length of time some warning signals were necessary to accomplish this result. W. F. Lewis of the General Electric company stationed himself directly behind the president's chair with a push-button which operated a bell in the northeast tower of machinery hall. In the tower was the stand of F. H. Dorr, who controled the various

water effects of the fountains. He was in communication with both fountains and with the pump house by electric bells. Three minutes before the president touched the key Mr. Lewis signaled to Mr. Dorr. The latter transmitted the signal to the pump-house and to both fountains. In the pump-house the pressure was gradually raised to full load, and in the fountains men stood with their hands on the valves which controlled the

FIG. 2. HOW PRESIDENT CLEVELAND OPENED THE WORLD'S FAIR BY ELECTRICITY.—THE KEY EMPLOYED.

jets. At the same instant that the president's key was pressed Mr. Lewis again signaled to Mr. Dorr, who then signaled to the fountains for the men to open the valves wide, and as the pumps were started at the same instant by the president the fountains burst forth in one grand pyramid of water.

All these lines were tested carefully several times to prevent any accident that might at the last moment disarrange the final results.

The various actors who were "behind the scenes" met in the electricity building on the morning of May 1st, at six oclock, and, over an early "bite," went over the plans again and again, so as to be "letter perfect" in every detail, and then hurried away, each to practice his portion, to be sure that nothing had occured to spoil the looked-for result.

Much credit is due to Dr. J. Allan Hornsby, assistant chief of the department of electricity, and to Lieut. Spencer of the General Electric company for their earnest efforts for the success of the affair. And it was a success, as history will bear witness, for it can truthfully be said that "Cleveland touched the button and electricity did the rest."

American Institute of Electrical Engineers.

The annual meeting of the American Institute of Electrical Engineers for the reception of the yearly reports, the election of officers and the transaction of other business will be held at the headquarters of the institute, 12 West Thirty-first street, New York, at 4 P. M., Tuesday, May 16th. It is expected that this session will occupy about two and one-half hours. After adjournment, those who so desire will assemble at "The Arena," 41 West Thirty-first street, where dinner will be served. This will be a purely social gathering, to which friends may be invited.

The general meeting of the institute will be held on

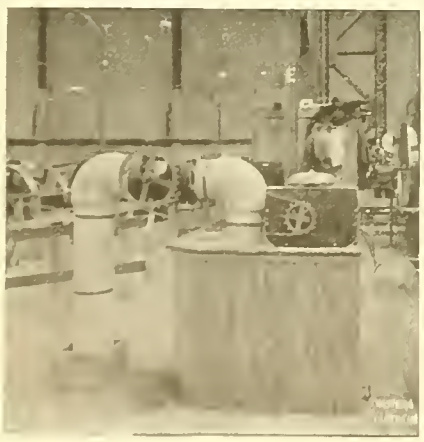


FIG. 3. HOW PRESIDENT CLEVELAND OPENED THE WORLD'S FAIR BY ELECTRICITY.—STARTING DEVICE ON THE ALLIS ENGINE.

Wednesday, May 17th. Two sessions will be held at which the following list of papers will be presented for discussion:

"On the Behavior of Fuse Metals in Direct and Alternate Current Circuits," by Charles P. Matthews of Cornell University, Ithaca, N. Y.

"A Modified Deprez D'Arsonval Galvanometer," by Lieut. Charles D. Parkhurst of Watervliet Arsenal, West Troy, N. Y.

"The Variation in Economy of the Steam Engine Due to Variation in Load," by Prof. R. C. Carpenter of Cornell University, Ithaca, N. Y.

"An Automatic Printing Speed Counter for Dynamo Shafting," by Prof. George S. Moler of Cornell University, Ithaca, N. Y.

"Practical Aspects of Electrical Resonance," by Dr. M. I. Pupin of Columbian College, New York city.

"The World's Electrical Congress of 1893," discussion of the provisional programme prepared by the Institute committee. This report with its appendices has been printed, and absent members are earnestly invited to contribute in writing any comments they desire to make.

"High Tension Generators for Direct Current Transmission," by Prof. Francis B. Crocker of Columbia College, New York city.

"The Heating of Armatures," by A. H. and C. E. Timmerman of Cornell University, Ithaca, N. Y.

Electricity at the World's Fair.

Aside from the electrical effects in the opening exercises, which are described by Mr. Etheridge in an article on another page, the first week of the World's Fair was not especially noteworthy from an electrical point of view. The electricity building was not open to visitors during the week, owing to delay in installing exhibits, largely caused by trouble in getting cars after delivery at the grounds by the railroad companies. The electric launches made regular trips and received considerable patronage. On the intramural line a train was running, but at infrequent intervals and carrying few passengers. Undoubtedly the number of persons carried on this road would have been much larger but for the chilly weather, which not only reduced the number of visitors but induced people to seek better protection from the penetrating wind from the lake than that afforded by the open cars on the elevated structure. The electric fountains were not electrically tested owing to the non-arrival of cable from Schenectady.

On the opening day one of the most picturesque features was the assemblage of electric launches and Venetian gondolas in the basin in front of the administration building. The boats made a very pretty appearance gliding about without noise or steam, and were the subject of many admiring comments. A view showing a portion of the water scene is presented in Fig. 1. After the president had formally opened the fair and had paid a visit to the great manufactures building, he was taken for a ride on one of the electric boats, the start being made at the landing at the northwest corner of the manufactures building. The throng was so great that the president was in imminent danger of being crowded off the landing before he could step into the boat. The little craft went down perceptibly when the weight of the nation's executive was placed upon it. The boat was No. 11 of the lagoon fleet, and was piloted by R. T. Garrabrant. It carried no awnings. Capt. Simonds received the voyagers and helped them into the five launches. No. 11 was first away and led the little fleet northward between the shores, which resounded with thousands of voices. The president sat in the stern with Director general Davis at his left and President Palmer at his right. After traversing the lagoon in a course closely skirting the shore, the voyage was completed at the steps leading up to the agriculture building, where the party took carriages again. The photograph reproduced in Fig. 2 shows the presidential party in electric launches near the point of debarkation. President Cleveland is shown in the leading boat, and, as he is standing up in the stern, his figure can be readily distinguished.

One of the General Electric company's exhibits is a Lake Erie upright engine of the marine type directly coupled to a 75 kilowatt multipolar dynamo. An annoying accident occurred as this engine was being taken from the car on which it came. Through the carelessness of some workmen the heavy engine was allowed to drop to the ground, wrenching off the governor and otherwise badly damaging it. The exposition staff of the General Electric company is indignant at the carelessness displayed, for which, it is asserted, there was no excuse.

Prof. Elihu Thomson's apparatus for producing high potential discharges has arrived in the electricity building, and already attracts much attention. Sparks three or four feet long will be produced at an estimated difference of potential between the terminals of one million volts. Oil insulation is used according to the method described by Prof. Thomson in his recent article on the subject published in the WESTERN ELECTRICIAN. The phenomenon will form one of the most attractive features in the building and will be sure to draw a wondering throng. The apparatus is in charge of A. Howland, who superintended the shipment of all the World's Fair material from the Thomson Houston factory at Lynn.

It is an interesting fact that, although nearly all the exhibits in electricity building are now well along toward completion, but four were completely ready on the opening day. The exhibitors who comprise this roll of honor are Queen & Co., the Thomson Electric Welding company, Day's Kerite and H. T. Paiste & Co.

FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.—ELECTRIC LAUNCHES IN THE GRAND BASIN.

Much energy is displayed in the work of completing the electrical construction work at the World's Fair. About the great central court the incandescent wiring for the administration building, music hall and peristyle is entirely finished, and all the lamps are in position. The exterior incandescent lighting of the administration building has been completed, and the long rows of lamps about the cornices, on the ribs of the dome and around the lofty corona give a beautiful effect at night, outlining the beautiful building in lines of light. The eight fifty-light standards, illustrated in the WESTERN ELECTRICIAN a few months ago, which are the most elaborate incandescent lighting fixtures at the park, are also in place in this building, which is now brilliant with 4,950 incandescent lamps. The electrical fountains have successfully withstood the hydraulic test, and the lamps will soon be in position. The temporary pole line, which has proved so useful in the construction operations on the grounds, although contributing in no way to the beauty of the park, has all been taken down, and of course all work now undertaken is of a permanent character. The demand for light, both arc and incandescent, is still great, however. Although much work is being accomplished, the lights would be put in with still greater rapidity if more wiremen could be obtained. About 500 men are now at work on electrical construction at the grounds, but four times that number would be employed if they could be secured.

About six new arc circuits of 50 lights each are being put in every day. The agriculture, manufactures, transportation, horticulture, fisheries and Illinois state buildings are now completely wired, with lamps, and the leather and forestry buildings are also wired, but are not connected with the circuits. Lights are also burning in some of the

other buildings. All the patrol lights are burning except those in the Midway Plaisance and the extreme southern portion of the grounds, about 500 in all. It is expected that all the arc lamps in the park, except those used for lighting the stock exhibit, will be in operation in two weeks. The lamps now in use for patrol lighting are principally Brush and Standard.

O. S. Platt of Bridgeport, Conn., manufacturer of switches, will make an exhibit in electricity building in connection with the Electric Appliance company.

The British government has been invited by the American minister to nominate five official delegates to the World's Electrical Congress at Chicago on August 21st and the following days. The royal commisson for the World's Fair has requested the foreign office to nominate the following named gentlemen: W. H. Preece, F.R.S. (president Institute of Electrical Engineers); Prof. W. E. Ayrton, F.R.S.; Major Cardew, R.E.; Alexander Siemens and Prof. S. P. Thompson, F.R.S.

Marquis de la Touanne, an engineer attaché to the ministry of posts and telegraphs of Paris, France, is the official delegate of the French government for the department of electricity at the World's Fair. He says that France is making an exhibit which is largely historical.

Lieut. E. J. Spencer, who is in charge of the General Electric company's interests at the World's Fair, has removed his office from the room temporarily occupied by him at the southern end of electricity building in the gallery to the structure erected for the offices of the company on the ground floor of the big building, near the "tower of light." The room thus vacated is next to Prof. Barrett's quarters and will be fitted as a private office for the chief of the department.

In the northeastern corner of electricity building, on the ground floor, the E. S. Greeley & Co. of New York is arranging an extensive and attractive display. The exhibit is shown in show-cases, which contain finely finished instruments, laboratory appliances, annunciators, batteries, telegraphic apparatus, electric bells, switches and specialties of all sorts. Everything is plainly labeled in large letters—a plan that may be commended to other exhibitors. A number of electric bells are arranged in an achromatic scale, and wired in series with a key-board, so that airs may be played. This company manufactured the golden Victor telegraph key used by the president in setting the Allis engine in motion, and this dainty bit of apparatus, together with the original battery cells and wires will be on exhibition. A pyramid showing 109 styles of primary batteries will also be a feature. Telegraphers will be given an opportunity to test the Victor key in connection with Morse, European and "tell-tale" registers.

James Dredge, one of the British royal commissioners to the World's Fair and the well known editor of London *Engineering*, was entertained at dinner on the evening of May 3d by the Western Society of Engineers. Mr. Dredge has been one of the staunchest upholders of the exposition in England, and the value of his services, extended personally and through the columns of his admirable journal, has been gratefully recognized by the friends of the fair.

Queen & Co. of Philadelphia are making a fine display of electrical instruments in their space on the ground floor of electricity building, near the northern entrance. The company also has four exhibits of scientific appliances in manufactures building. The features of the total exhibit are described in a pamphlet entitled "Some Features of the World's Columbian Exposition."

Prof. Elisha Gray, chairman of the World's Electrical Congress, received the following cablegram from W. H. Preece of London, England, on Monday:

The electrical engineers of England, dining together at their club to-night, desire to convey to their professional brethren in Chicago sincere congratulations upon the opening of their grand exhibition. We hope to appear in person in August next to support the success of your magnificent undertaking.

To the list of engines in the electrical service plant in machinery hall, published last week on page 246, one New York Safety 150 horse power engine should have been added.

FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.—PRESIDENT CLEVELAND IN AN ELECTRIC LAUNCH.

Electric Stations as Insurance Risks.

The fire hazard of electric lighting, though a well-worn subject, succeeds in cropping up from time to time, and is the theme of many a paper, and the fruit of many a discussion. In this country, however, says the London *Electrical Review*, matters have so far settled down that we now rarely hear of those mishaps formerly attending electric lighting, and the fire offices have little to complain of in the way of so-called electrical fires. In America, however, the case is somewhat different. Complaints still reach us of the unsatisfactory—not to say slipshod—manner in which many of the installations are carried out, and we believe the fire offices have good cause to regard the "light of the future" as anything but an unmixed boon in that country. It would appear, also, that the same experience applies to the generating stations, which have proved during the past few years to be very unremunerative risks; so much so, indeed, that some insurance companies decline to entertain them on any terms, while others charge practically prohibitive rates, or impose conditions unacceptable to the lighting interests. Why the grinding out of electricity should be so hazardous an operation in the states is more or less a mystery, and we have for a long time looked in vain for some statistics dealing with the question.

George P. Low of San Francisco has endeavored to supply the want by a paper read before the Fire Underwriters' Association of the Pacific, as published in the WESTERN ELECTRICIAN of March 18th last. It is true the results of a canvass by circular of the 180 stations within the jurisdiction of the association are somewhat disappointing, only 87 having responded, and the greater part of these returned figures only for the year 1892. Still they are interesting, and, in a measure, reassuring.

It is now pretty evident that the high loss ratios are due not to this or that particular system of distribution, nor to any particular device or apparatus employed—in fact, to nothing that may be said to be specially inherent in electricity itself—but to causes appertaining to any factory or works where power is employed, and where the arrangements for such are faulty. During the rush in the early days of electric lighting any shanty was considered good enough for a generating station, the main thing being to get the current along and the money coming in. Hence it is not surprising to find that of the 87 stations referred to, nearly 50 per cent. are timber buildings, and several are joint occupancies with other risks, such as planing mills, saw mills and flour mills.

The estimated value of buildings and plant of the 87 stations referred to amounted to about £832,857, upon which insurances were effected to the extent of £175 494, at an average rate of nearly 2 per cent., and it is satisfactory to know that during last year these particular stations suffered damage by fire to the extent only of £690. The causes are attributed to hot bearings, defective fire-box, and "general fires," by which we presume is meant neighboring fires. Unfortunately no information is forthcoming of the experiences of the remaining 93 stations.

Turning to home, the contrast is striking. Our public supply companies find it to their advantage to erect most substantial structures for their generating stations, built to stand for all time, and in which they provide against fire by the simple expedient of excluding from their boiler houses and engine rooms anything of a combustible nature. Hence there is no difficulty in effecting insurance to any extent required, and at very moderate rates.

In the states improvements are being effected in this respect. Stations are now being erected that, from the fire point of view, leave little to be desired, and the day, let us hope, is not far off when the wooden shanty with its greasy floor will have become a thing of the past.

Electric Light Station in the Champs Elysees Sector, Paris.

The first station for the distribution of electricity in Paris was a modest venture, and, comparatively speaking, the city was backward in the introduction of the new illuminant. On June 20, 1887, the Dronot station was officially opened by Charles Mildé, president of the administrative council of la Compagnie Francaise d'Eclairage Electrique. The station was able to supply only 1,500 lamps at the maximum. Five years before the date mentioned the Pearl street station of the Edison company in New York was in operation. Since that time progress in electric lighting has been rapid, the development dating especially from 1888, when five companies received concessions for lighting five sectors of the city on the right bank of the Seine.

On the first day of March last there were still two sectors unprovided with electric light. These were the Champs Elysees on the right bank and that of the left bank of the Seine. It is likely that it will be some little time before the latter district is electrically lighted, but on March 7th the new plant of la Compagnie Parisienne d'Eclairage Electrique du Secteur des Champ Elysees commenced to supply current in the territory in which it is located.

The Champs Elysees sector covers an area of about 4¼ square miles, and is for the most part a residence district. There are few business blocks, and the consumption by subscribers will be generally small. Statistics gathered in similar districts in other large European cities prove that localities of this description are the least profitable to the electric light company. The concessions for electric lighting, granted by the city of Paris cover a period of only eighteen years, at the expiration of which time the conduits become the property of the municipality. The companies naturally are inclined, therefore, to reduce the investment in the distributing system as much as possible.

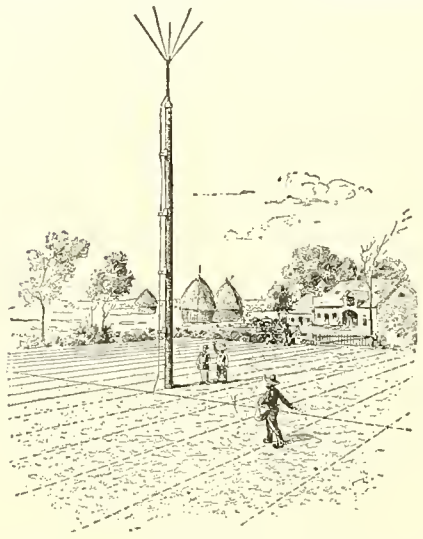
The company decided to install an alternating current system with a potential of 3,000 volts in the primaries. It was also determined to adopt machines of low frequency, not over 40 periods per second, to facilitate coupling dynamos in parallel and to prepare the way for the employment of alternating current motors.

The station is located at Levallois-Perret on the bank of the Seine at a point convenient for receiving coal and obtaining water for the boilers and for condensing purposes. The structure was built of iron and brick and rests on a foundation constructed on piles.

The boilers, which are five in number and of the Galloway type, were built by Renaux Fils et Bonpain, of Rouen. Their capacity is 6,500 pounds of steam per hour. Water is pumped from the Seine, passing first through a Gaillet filter and thence to a Green fuel economizer in which the temperature of the feed water is raised to 100 degrees C.

The engines are in three groups, Fig. 1. The first consists of a pair of Corliss engines, driving a 400 kilowatt alternator and a 25 kilowatt exciter. The second and third are Corliss engines driving 400 kilowatt alternators and 25 kilowatt exciters. The engines, which are condensing, were constructed by the Tarcot company. The three alternators now installed were built by Hillairet & Huguet of Paris. They have fixed armatures with rotating fields, which are mounted on extensions of the engine shafts. The fields are 22 feet 10 inches in diameter and have 80 poles. The number of armature coils is the same. The output of the machines is 133 amperes at 3,000 volts, while the normal capacity of the machines is 400 kilowatts; they can be worked up to 455 kilowatts if necessary. Their commercial efficiency guaranteed by the builders is 85 per cent.

The switchboard shown in Fig. 2, E. Hospitalier says in a recent article, is one of the most complete to be seen. All the circuits and the connections are in plain sight and all wires traversed by alternating currents are painted a bright red to attract the attention of the operator who is never allowed to touch any apparatus until he has drawn on a pair of rubber gloves. Opening or closing the high tension circuits is effected by stationary connections which are brought into circuit by means of mercury contained in ebonite vessels. This operation is effected by means of levers arranged in a line across the board. The switchboard is 13 feet in height and 65 feet 6 inches in length.



THE GEOMAGNETIFERE.

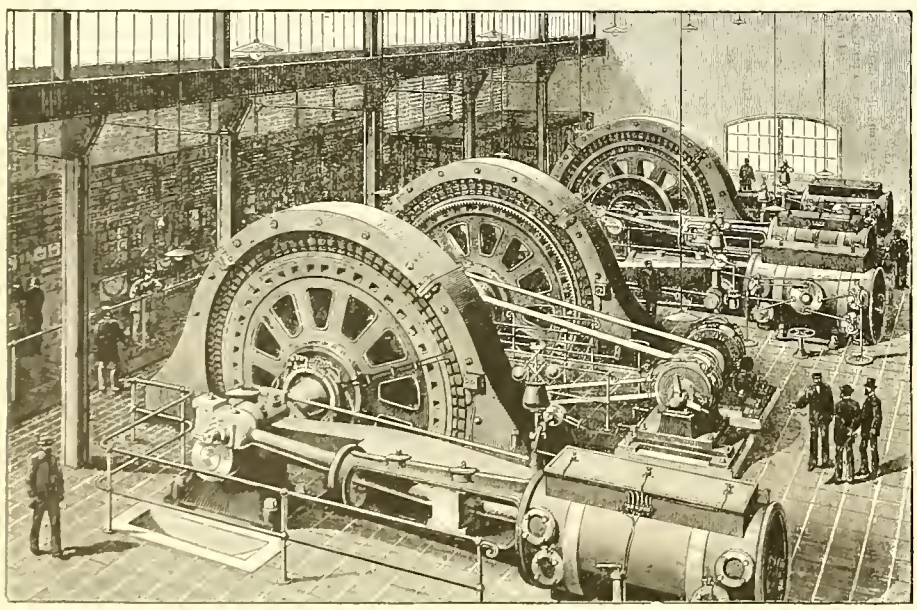


FIG. 1. ELECTRIC LIGHT STATION IN THE CHAMPS ELYSEES SECTOR, PARIS.

The current is distributed by Berthaud-Borel concentric cables made by the Cail company. The resistance per kilometer between the two conductors ranges between 4,000 and 5 000 megohms. The following table of megohms per kilometer was obtained by tests of the cables now laid, with lines to houses connected up:

	Maximum.	Minimum.	Average.
Resistance between central conductor and the earth.....	9,185	4,843	7,083
Resistance between annular conductor and the earth....	3 091	1,930	2,226
Resistance between the two conductors.....	6,030	2,900	4,847

When the cables are placed under the sidewalks they are merely laid in a trench on a layer of sand, which facilitates the drainage. Above them is placed a thin tile and nearer to the surface a wire screen to protect them from the tools of workmen. In the streets the cables are laid in cast iron pipes.

The transformers in use are the new Zipernowski type shown in Fig. 3. The sizes employed are 1, 2, 5, 10 and 25 kilowatts capacity. The Thomson meter is employed for measuring current. The prices charged for current vary in accordance with the amount of consumption. In private hotels and residences where the requirement is small the charge is about a cent per lamp-hour for a 10 candle power lamp. The largest consumers are charged about 20 per cent. less. The cuts are reproduced from *La Nature*.

The Geomagnetifere.[1]

By C. Crepeaux.

Does electricity, that has transformed almost all our modern industries, exert a favorable influence on vegetable growth? Can it be applied by the agriculturist to increase germination, to secure a more perfect development of a plant, and, as a consequence, to produce a greater crop? These questions have been much discussed lately, and different opinions have been expressed. There has been no lack of experimenters in this field, for since the time of Abbe Nollet, von Maimbray, Menon and Bose, who instituted investigations about 1750, there may be noted the names of Abbe Bertholon (1785), Jallabert, Gardini, Ingenhauss von Carmoy, Vassali, d'Orooy, Rosiere, Bilsborrow (1797), Rouland, Humboldt, Senaebrer (1801), de Candolle (1806), Reuter, Sheppard (1840), Forster Beckeinstener, Hlubeck (1847), Herve Mangon, Mm. Prilleaux, (1861), Frestier, Barat (1875), Werner Siemens (1880), Deherein (1881), Grandeau, Leclerc, Celi, Wollny, Mecagoo, Mallet, Deletrez, Spechnew, Rivaire, Selim Lemstrom, Naudin, Carola, Bailey, Tallavignes, G. Bonnier and E. Lagrange (1892). There have been so many contradictory results that nowadays everyone looks skeptically at all that relates to electroculture. However, it must be borne in mind that negative results are without convincing force in the face of results that are positively demonstrated and are reproduced at will. All previous methods of electric cultivation have, more or less, completely failed; still this proves simply that these means were defective and does not involve the failure of a different method.

The new process of electroculture, invented by Brother Paulin, was studied by him in a series of experiments scientifically conducted, and is based upon a sufficient number of demonstrations to arrest attention. Brother Paulin devoted himself for an extended period to the study of electric culture, but when he had reached the point where he was convinced of the fact that electricity exerted a favorable influence on vegetable life, it was still necessary to pass from theory to practice, and to determine the best means of utilizing it. It is for this reason that his practical experiments date back only two years.

By a device of his own invention, which he calls a "geomagnetifere," he attracts electricity that is found in the atmosphere near the earth in consequence of meteorological phenomena, such as storms, rains, wind, etc., and distributes it in the ground in the vicinity of the roots of plants. The "geomagnetifere" is a resinous pole, ranging in height from 40 to 60 feet, which is planted in the ground, and which supports by means of porcelain insulators a galvanized iron rod, the latter terminating in five copper points as shown in the illustration. This collecting brush is connected by means of the rod with a system of wires 6 feet 9 inches apart, which distribute the electricity in the ground which it is proposed to influence. This area depends upon the height of the pole. An area of 30 areas (3,588 square yards) for example is allowed for a pole 15 meters (49 feet 2 inches) in height. In the illustration the wires are represented on the surface to indicate their arrangement; in practice they are buried to a depth of from six to eighteen inches. Such an installation lasts many years; the apparatus operates until the conductors are destroyed by rust.

The first experiment made by Brother Paulin was conducted in the spring of 1891 in a potato field belonging to a farmer in the suburbs of Montbrison. In July a report of the result was made in the papers to the following effect: "The attention is arrested at once by a marked irregularity in the vegetation in the field. In an exact circle in which the electric conductors are buried, the potato plants have a growth double that in the rest of the field. And this is true without exception; there is no gap in the group of five plants forming a circle as exact as if drawn by a compass."

Here is the report of the committee appointed by the Agricultural Society of Montbrison that awarded a medal to Brother Paulin: "A geomagnetifere twenty-eight feet in height exerted its influence over an area 65 feet 5 inches in radius. In this part of the field the stems of the potato plants have attained an extraordinary size and development, and have preserved at this time (September 23d) a freshness that contrasts very perceptibly with those in neighboring parts of the field. The stems were measured and were found to reach a height of 57.87 inches and .787 inches in diameter. After the first investigation the members of the committee designated for future comparison two portions of that part of the field traversed by the wires, each containing 16 squares meters, and two portions of the same size not subject to the electrical influence. These four patches of ground were not chosen for any particular reason except that they represented the average vegetation in both parts of the field. The 32 meters in the former area yielded 198 pounds of potatoes, while the same area in the uninfluenced portion of the field produced 124 pounds." The production per hectare (2.47 acres) in the first case would be 61,600 pounds and in the second case 41,140 pounds. This

1. Abstract of an article in *L'Illustration*.

result attained without any special fertilizing and with a common variety of potatoes equals the best crops obtained at large, expense with chemical fertilizers. On the 11th of October the difference was still more marked; 60 square feet in the area subject to the electrical influence yielded 1.38 pounds of potatoes, while a similar area in the other part of the field yielded 83 pounds.

The second experiment was made in a vineyard. The report states that the grapes ripened more rapidly and more steadily in the circle bounded by the wires than in the ground outside of it.

The following are some of the results obtained in the following year (1892). In the enclosure of the Brothers of the Christian Schools (Novitiate of Vals near Puy) a geomagnetifere 94 feet in height was erected on April 24th in a field of spinach sowed the previous year. From the first few days in May it was possible to notice a difference both in the vigor and color of the plants in the patch of ground in which the wires were buried. The contrast was marked by a straight line following the direction of the conductors. On the 14th of May plants in two areas of 5.40 meters each in the influenced and uninfluenced parts of the field were dug up with their roots, and were weighed. In the former area the total weight was 53.68 pounds, and in the latter case 44.34 pounds, or a difference of 1.91 pounds per square meter. On the 21st of May the difference was found to be 3.08 pounds per square meter, and six days later a commission of professors and agriculturists investigated the action of the geomagnetifere and found it had then produced a difference of 3.96 pounds per square meter. At Thueyts (Ardeche) spinach has been grown with leaves 13.78 inches in length, and celery 35.43 inches in height. At Tours the stems of the potato plants attained a growth of 96.45 inches; in Haute Loire the radishes and turnips reached a spendid size; at Orchies, the beet roots grown for sugar were of fine quality.

How does electricity produce these remarkable results? Does it act by means of the decomposition of the air and the fixation of the azote, or does it operate simply by making the useful elements in the soil assimilate more perfectly and rapidly? These are problems that are still to be solved.

The Thiele Bill and Socialism.

By Allen R. Foote.

In the issue of the Western Electrician for April 29th I notice your report of the views of Mr. Wilmerding on the "Thiele electric lighting bill" and your editorial referring to the same. Not having the bill before me I cannot discuss its provisions, but I am willing to accept your editorial statement that "this measure is thoroughly bad in principle antagonistic to legitimate enterprise, and will have a tendency to frighten capitalists who would otherwise invest in electrical work. The bill should be defeated."

From a long and careful observation of the progress of socialism in this country I conclude that the success it has met with is wholly attributable to the fact that those most directly antagonized by the movement—corporations supplying public services—have been placed at a disadvantage in their efforts to stay the rising tide of paternalism by the popular prejudices against corporate monopolies and trusts.

The popular prejudice against monopolies has made politicians and the daily and weekly newspapers—politicians in type—ever ready to dilate on the wrongs inflicted by them and the blessings to accrue from having them supplanted by public ownership of all public service industries. Another powerful influence is be found in the insatiable greed for political power always firmly rooted in the occupant of every public office and in every public employe. Politicians by sheer force of logic, as they reason, must advocate public ownership of these industries, because they wrongly assume that to advocate any other course would be a confession on their part of inability to manage public affairs. Editors of newspapers show the same dread of a damaging admission when they decline to publish a communication showing errors in their editorials or in articles which they have published with comments of approval.

I have seen no better statement of the dangerous growth of socialism than that made by Frank B. Tracy in his article in the *Forum* for May, 1893, on "Menacing Socialism in the Western States." I wish every one of your readers could be induced to read that article. To be told as they are there told, "in the deliberate and conservative judgment of the writer, that socialists constitute a majority of the citizens of the West" must have a startling effect on most of them. And then, when a little farther on the reader comes to the following statement, it can but cause him to pause and pass some time in serious reflection: "Every intelligent student must realize that unless the spread of socialism is checked, one of two conditions will certainly appear in time. One is the thorough paternalization of our government; the other is the political separation of the West from the East."

The remedy suggested by Mr. Tracy is an old and reliable one—the proper education of the masses. I am one of those who have complete confidence in the honest intentions of the average man. Unfortunately, honest intentions are not all that is required to cause political actions to result in sound economic procedures. Such results can come only from honest and well-informed political action. How can the average man become well informed regarding the economic conditions involved in the question of municipal ownership of electric lighting plants or any other public service industry? Some sentimentalist writes an abusive article about monopolies in general and clinches his argument by showing how cheap the city could get electric lights or gas, if the city would only destroy the monopolies by erecting and operating works of its own. The paper publishes his article as a sensation, just as it would a lurid account of a robbery or a murder. The average man reads it. Having no means of testing the correctness of the figures and no reason for disputing them, he accepts them. They are against monopolies, against capitalists and in favor of the people, in favor of honest labor.

The local company that finds itself in danger commences

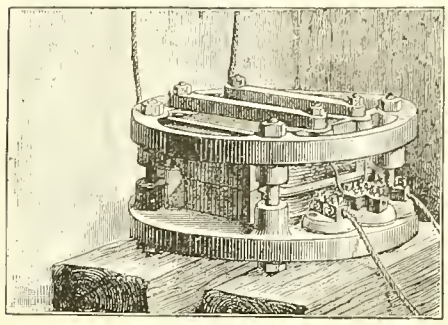


FIG. 3. ELECTRIC LIGHT STATION IN THE CHAMPS ELYSEES SECTOR, PARIS.

to write to all it thinks may help it, for statistics and arguments to be used against the craze. Some one takes up its case and writes an article suitable to it and sends it to an electrical journal, where it is sure to find a cordial welcome. It is published in such a journal and is never seen by the average man, the voter; who controls the destinies of state. In this way there has been sufficient evidence published in electrical and other technical journals during the last five years to satisfy any man with an intelligent reasoning mind that public ownership of public service corporations invariably results, and must inevitably result, in economic losses instead of economic gains for the people. Notwithstanding this the gains made by socialistic ideas during this same period of five years are astounding to those who take the trouble to keep themselves advised. This lost ground must be recovered and gains must be made for correct economic ideas, or, as Mr. Tracy says, our entire government will be transformed into one vast scheme of paternalism. This raises the question, How can the masses be taught correct economic ideas? To keep as near as possible to the subject that has caused the writing of this article, I suggest that whenever an article appears in any newspaper or other publication favoring any socialistic scheme, or giving figures showing the advantage of municipal ownership, that an article be written to refute the arguments, or to disprove the figures, and that it be published in the same newspaper in which the article to which it is an answer appeared. The objective point is to give the antidote to the same persons who took the poison, the readers of that newspaper. Let this course be persistently followed and its good effects will not be long in appearing. It must not be supposed that newspapers will be so eager rightly to educate their readers that they will be glad to publish articles correcting statements made in their editorials or in communications which they have accepted and speeches they have reported with approval. Not a bit of it. On the other hand, they will frequently find it necessary to decline such articles "for want of space." When this is done there comes the opportunity to show that some one is in dead earnest in following up the subject. The declined articles should be at once inserted as a paid advertisement. The publisher should be made to know that he will not be allowed, unchallenged, to corrupt the minds of his readers with misinformation. One other point: the article should be furnished by a writer known to have no invested interest in the industry attacked. If a bright, respectable, ambitious mechanic can be found in the town who will read up on the subject and sign the articles, their effect will be much greater than if signed by the president of the local corporation being attacked.

The political and economic questions involved in every discussion of socialistic schemes touch the interests of every public service corporation. As each must defend itself when attacked, the common danger and similarity of interests should bind them into one cohesive force, not only to repel all socialistic proposals but to take the offensive and deprive the sentimentalists of their power to pose as friends of the people through causing the people to see that their theories are subversive of industrial liberty and economic justice. To illustrate this point, one argument against the Thiele bill is found in an article by J. W. Mason on "Governmental Ownership of Railroads" in the *American Journal of Politics*. In this article Mr. Mason says:

"In the kingdom of Norway and Sweden much may be learned that is instructive. In 1888 there was a total of 4,591 miles of railway in that country; of these 1,551 miles were built, owned and operated by the government, while 3,040 miles were built and operated by private corporations. It cost the government to build and equip its road over $41,000 per mile. The private roads were built and equipped for a little over $22,000 per mile—a trifle more than one-half of what it cost the government. The roads, private as well as public, are under control of the government, with rates fixed by royal administration and approved by the king; and yet the private roads, after paying interest at four per cent. on a bonded debt of $12,800,000, pay a dividend of 3.24 per cent. on the capital invested, while the government roads, after paying operating expenses, show a surplus of but 2.41 per cent. of the cost. No comment can add to the force of these facts. I put them forward in proof that business industries cannot be so successfully and economically carried on by the government as by private enterprises."

The Thiele bill is intended to authorize municipalities to undertake the management of business industries. Politicians have never yet succeeded in managing business affairs as well as business men who have their own capital staked on the success of the enterprise. It is not in the nature of things that they should. They are not built that way.

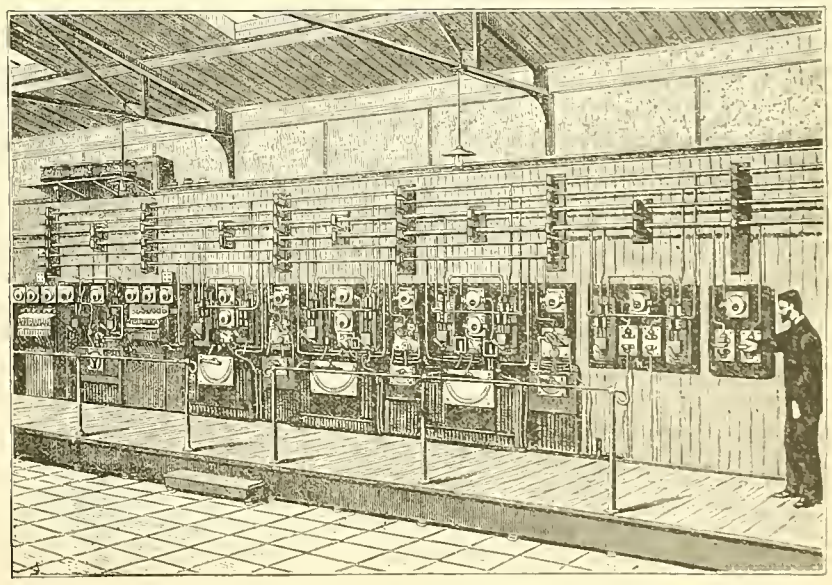


FIG 2. ELECTRIC LIGHT STATION IN THE CHAMPS ELYSEES SECTOR, PARIS.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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VISITORS

To the World's Fair are requested to forward their addresses to the WESTERN ELECTRICIAN as early as possible or notify us immediately upon their arrival in Chicago.

THERE seems to be a growing disposition on the part of the men engaged in electrical construction work to follow the policy of the older labor organizations and take advantage of the pressing needs of the corporations to extort excessive wages. Such a policy is short sighted in the extreme, and will ultimately react upon the laboring men. It will only serve to create a breach between employes and employers, and the former cannot complain if, when there is little work to be done, the employers retaliate by cutting the price of labor so as to average up on the general run. Such a condition of affairs is to be deplored as it is to the interest of both the employer and employe that friendly relations exist between them.

Elsewhere in this issue is presented a carefully prepared article by Allen R. Foote, which should command the attention of every man who is interested in any way in electric lighting, railway or power work. As is well known Mr. Foote has devoted considerable time to the collection of statistics on central station work and is thoroughly familiar with the subject. His experience has led him to conclude that the growing tendency in favor of municipal control of enterprises that should be conducted by private capital is due largely to erroneous statements published in daily newspapers and popular periodicals, and in the utterances of irresponsible politicians who hope to win favor by appealing to ignorant people who are ever willing to take a position against capital. Mr. Foote's plan is to refute all of these erroneous statements immediately after their publication, in fact to establish a literary bureau on a small scale in every locality where the central station men's interests are threatened. The scheme will bear consideration.

IT is now an assured fact that the electric lines in the South Chicago suburban district will be extended during the summer months and that within a year a comprehensive system of trolley lines will be thoroughly established in that section of the city. The ordinance providing for these important extensions has been passed and the mayor has expressed a willingness to approve it, upon the execution of a satisfactory agreement with the city electrician to insure non-interference with the city's electric system. A conference of the representatives of the company and the city resulted in the settlement of the terms upon which the work shall be conducted, the street railway company announcing its willingness to place the city's wires underground wherever the trolley lines crossed the city's circuits and take any other precautions which Prof. Barrett might deem necessary. This spirit of fairness manifested by the railway company is commended to the attention of other corporations seeking franchises from municipalities. They will find that the public will much more readily grant them concessions and that the companies will stand better in the estimation of the community. They will find, too, that a liberal policy will pay in the end.

AN interesting account of the manner in which electricity was utilized in the exercises at the opening of the World's Fair is given in this issue by Locke Etheridge, who tells "How President Cleveland Opened the World's Fair by Electricity." Mr. Etheridge had charge of the electrical arrangements and is well qualified to describe them. Up to the last moment there were many who believed that an electric signal would simply be sent by the president to men at the Allis engine and in the pump house, and that the steam valves on the big engine and fountain pumps would be opened by hand. It is satisfactory, therefore, to be assured that the electrical impulse caused by the pressure of the president's finger did actually control the mechanism by automatic action. Of course the result was not achieved without careful preparation and many rehearsals, and all concerned breathed more freely when the critical moment was passed, and the "button-pressing" episode had proved an entire success. All who witnessed the impressive scene at the opening will agree that the arrangements could hardly have been improved. The instant that President Cleveland touched the key the fly wheel of the Allis engine and the pulley of the great dynamo belted to it began to revolve, while the electric fountains spouted outside. At almost the same moment a large American flag on the central staff in front of the administration building was unfurled, while scarcely a second later the display of the ensigns of all nations became general from a multitude of flag-staffs on the beautiful buildings surrounding the grand central court. The spectacle was very beautiful and impressive and was greeted with tremendous cheering by the great concourse of visitors. The bands played and the boats in the basin screeched, but above all was the exultant shouts from seventy thousand human throats. That electricity should have contributed so largely to the success of this memorable celebration is a cause for gratification to all connected with the industry.

OFFICIAL consular reports during the last few years have directed the attention of American manufacturers of electrical machinery to the demand in foreign countries for the class of apparatus which they are supplying. One of the latest of these reports is that of John Fowler, United States consul at Ningpo, China, which has just been published. Consul Fowler has succeeded in arresting the attention of the taotai of the circuit in the subject of electric, steam and oil launches. As that official is obliged to travel a great deal through canals and rivers, he is naturally inclined to take advantage of the modern methods of transportation, especially in view of the fact that much higher speed may be attained and greater comforts enjoyed than under the old methods, which are still retained in the Orient. At present he is obliged to depend upon boats which cannot make more than 100 miles in three days, and which are propelled by scullers. The taotai is not the only person who would take advantage of improved forms of boats and means of propulsion. It should be remembered that this vast district is intersected by thousands of miles of canals and rivers, and although it covers a territory of 39,500 square miles and has a population of from 25,000,000 to 35,000,000 people, there is not a single launch or boat of any kind propelled by steam, oil or electricity, excepting a few launches that ply from Shanghai to Hangchow, the capital, 150 miles northeast of Ningpo. The conditions existing in China are much more favorable to the electric launch than to steam and oil launches. Objection is made to smokestacks on the boats, and only very low or short stacks would be tolerated. A boat "without a smokestack" would be very popular, according to Consul Fowler. Concluding, he says: "The canals are the only roads, and all travel is, of course, by boat. The traffic carried on by boats is very large. The introduction of quicker methods of travel would be highly appreciated, especially if the taotai sets the example, and I deem this a most auspicious time to introduce our methods into this province."

This is highly gratifying and encouraging to those introducing electric launches. That such boats can be built and operated economically there can be no doubt, and that they are deservedly popular is apparent to all who have witnessed their operation on the lagoons at the World's Fair.

SERIOUS attention is given the project of Prof. Lucien I. Blake of the University of Kansas to transmit electric power from the coal field to Kansas City. Prof. Blake is reported to have said that nearly one-half the price that the consumer pays for coal is for transportation. He proposes to build at each large mine an electric power house. He would generate electricity at the head of the shaft and transmit it to the city, where sub-stations could regulate the distribution of the current. He claims that power could be furnished at least 30 per cent. below its present cost and that by his plan the smoke nuisance would be abolished. Prof. Blake adds:

The cost of the electrical equipment can be only roughly stated. As proposed at Niagara Falls it is about $180,000 for 5,000 horse power units, which includes generators, exciters, transmitters and line for twenty miles, but not the motors. They would be paid for by subscribers. The line construction would cost something like $1,000 per mile. Thus it would seem possible to make a successful and commercial venture of such utilization of our coal mines. There is at least this to be said: Our best and most reliable electric companies would be ready to make estimates upon such a project and thus from this standpoint such a project warrants serious attention. Power is now conveyed by electricity 112 miles to Frankfort, Germany, with a loss of only 28 per cent. The plant lights 160,000 lamps and runs a twenty horse power motor. At Ouray, Colo., at Telluride and Portland, Ore., it is also transmitted cheaply by electricity, and a company is preparing to transmit power by electricity from Niagara Falls to Buffalo.

There is, according to the statement of Prof. Blake, enough coal within a radius of 50 miles to supply Kansas City for many years.

The plan prepared by Prof. Blake is of course feasible, but it is considered impracticable from a commercial point of view unless certain favorable conditions prevail. If, for instance, there was a coal mine at the foot of a mountain, and a rich mine located 10,000 feet above, it would probably be cheaper to transmit electric power up the mountain than to haul coal, but such conditions hardly exist in Kansas City. The whole question therefore resolves itself into whether it is cheaper to carry coal or to generate steam at the mouth of the coal pit, and transmit power electrically to the point where it is needed. If transportation is cheap and the distance great, it will of course be much more advantageous to carry the coal by rail or water and have a steam plant in the the center of distribution. If, on the other hand, the distance is comparatively short, and the cost of transportation very high, such as might be expected in a country cut up by mountains, forests or rivers, or where the point of application is situated near the mountain tops, electric transmission of power will be the cheaper. Generally speaking, it may be said that such schemes usually fail to attract capitalists for the simple reason that within a radius of 50 miles from a coal pit, coal is so cheap that it would be ridiculous to invest large amounts of money for electrical transmission plants, the interest on which would more than overbalance the cost of transportation of coal to the point of application.

An erroneous impression is conveyed by the statements attributed to Prof. Blake regarding the Frankfort experiments. It is well known that the Frankfort transmission plant was put up as an exhibition plant only, and in order to demonstrate the feasibility of power transmission at long distances from an engineering point of view, but it has never been a commercial success, and never was intended to be one.

A Sensational Charge.

[Special dispatch to the WESTERN ELECTRICIAN.]

BOSTON, MASS., May 8.—The Westinghouse Electric & Manufacturing company of Pittsburg on Saturday brought a suit against the General Electric company in the Supreme Judicial Court at Salem. The plaintiff filed a bill in equity in which it is alleged that the plaintiff has for some months suspected that the General Electric company was regularly and systematically receiving detailed information as to the prices the Westinghouse company was making to its customers, the new apparatus it was designing, the inventions made by its electricians and its business generally. It especially charge in its bill that many of the drawings and plans made in the designing rooms of the Westinghouse company got into the hands of the General Electric company very soon after they were prepared. The bill says: "About August 1, 1892, the defendant, the General Electric company, approached certain persons in the employ of the plaintiff who had access to the rooms in which the plans, blue prints, specifications and proposals were kept, and through secret negotiations and the payment of large sums of money bribed them to steal from the plaintiff from time to time thereafter and up to about the first of March, 1893, the blue prints of the most important and novel designs for apparatus machinery, and devices which were made from time to time by the employes of the plaintiff, and also to steal specifications and proposals of the character aforesaid."

The bill charges that these prints were given into the hands of E. Wilbur Rice, jr., of Swampscott and Walter H. Knight of Lynn, electricians and co-defendants in the action with the General Electric company. The bill then proceeds to give a list of the blue prints alleged to have been stolen. There are 180 of them. On May 4, 1893, the bill goes on to say, the plaintiff sued out a writ of replevin returnable to the Superior Court, County of Essex, on the first Monday of July, 1893. The sheriff of Essex county made a demand for the property in question, "but," the bill says, the "defendant refused to deliver up the property, and the deputy sheriff made a diligent search for the same in the premises of the defendant, in the office of the company, and particularly in certain drawers in the desk of said Rice, in which many of the said papers were known to have been deposited not more than six days prior to the delivery of the writ to the deputy sheriff, but the officer was unable to find the property or any part of it. The drawers of the desk in which the blue prints had been deposited six days before the issuance of the writ, and for some time previously thereto were empty. The prints had been removed therefrom and concealed by the defendants for the purpose of avoiding their being taken by said writ, and are now concealed by the defendants for such purpose"

The plaintiff prays: First, that the defendant may be ordered to deliver the blue prints and the copies of the specifications and proposals to the plaintiff; second, that the defendant may be enjoined from using the blue prints or from utilizing in any way any knowledge or information gained therefrom, and third, for such other relief as the court may deem meet. J. C. E.

A Chicago paper printed on Sunday a special dispatch from New York in which it was asserted that the Westinghouse Electric & Manufacturing company had charged the General Electric company with setting on foot a conspiracy to seriously injure the former by obtaining, by bribery and theft, plans of new electrical machinery designed by the engineers of the Pittsburg company. It was further asserted that a charge of criminal conspiracy, in which the officers of the General Electric company would be made defendants, would be pushed in the courts.

The gist of this serious accusation is contained in the following paragraphs from the article in question:

A few weeks ago the officers of the Westinghouse company were surprised to find that certain plans which they had made to be used in connection with their proposition for supplying a plant were identical with the plans which the company with which the Westinghouse people were to compete already had offered, and the engineer of the company said: "These plans are so similar that one of two things must have happened: Either you have stolen the plans from the General Electric company or they have stolen yours." The same experience occurred while negotiations were pending for contracts with the Niagara Falls Power company and again with a company at Sacramento, Cal., and once more at Providence, R. I. Therefore it was made apparent to the Westinghouse people that in some way their plans and specifications were being taken to the General Electric people.

It was felt by the Westinghouse officials that in self-protection some steps should be taken to find out how their business secrets were betrayed, and it was decided to employ the best detective skill that could be procured. This was done in the latter part of March, and a few days ago the detectives made their report. According to these reports, last July an arrangement was made with President Coffin of the General Electric, and William J. Clarke, who has been an able assistant to Mr. Coffin, and also with Morris Mead, the city electrician of Pittsburg, by which it was agreed that a competent man should be employed by the Westinghouse people, who would nevertheless be in the service of the General Electric company. They secured such a man, who has, it is said, made full confession to the district attorney of Pittsburg, and upon whose testimony the prosecution of Mr. Coffin and the others must be sustained.

A charge of felony was made against the city electrician of Pittsburg, Morris W. Mead, also against C. A. Coffin, the president of the General Electric company, William J. Clarke, Milton H. Hamilton, E. Wilbur Rice, Walter R. Knight, all of whom are prominent officers in the General Electric company.

A Pittsburg dispatch, dated May 6th, gives this information in addition:

Frank Carey, the Westinghouse draftsman charged with stealing blue prints at the solicitation of Mr. Mead and others alleged to be implicated in the conspiracy, was released from jail to-day on $500 bail. John Butler, the colored porter, who was arrested on the same charge, is still in jail, and will probably not be released before the hearing, which is set for 4 P. M. next Wednesday before Magistrate McMasters.

George Westinghouse, jr., dictated this statement: "The action which has been taken was an absolute necessity in view of the great injury being worked to the company by the conspiracy. But the matter is now in the hands of the officers of the commonwealth and must rest there, so that there is nothing which the company can properly say."

Later in the day Mr. Westinghouse made this additional statement: "In a letter just received from one of the engineers of the Westinghouse Electric & Manufacturing company at San Francisco, who was bidding on a plant for the transmission of power to the city of Sacramento, he writes as follows: 'You have, of course, heard the rumor that the General Electric company has obtained the drawings of our Niagara generator, and I think there is no doubt that they had all of the preliminary information which was sent to the Livermores as to the Sacramento plant before my arrival. The consulting engineer of the Sacramento company backs me up in this belief, because of the remarkable similarity in our plans.'"

The charge is vigorously denied by the officers of the General Electric company, who assert that the attack is made now to influence the selling price of General Electric stock. Mr. Clarke said that it was possible that his company had duplicates of Westinghouse blue prints, as customers had no difficulty in getting them, and by the same means the Westinghouse company might have got some General Electric blue prints. He characterized the search of his company's office at Lynn as vandalism.

Cincinnati Edison Company's Strike.

Cincinnati was much exercised last week over the rumored discovery of a plan to blow up the Edison Electric company's station. About three weeks ago the linemen in the employment of the Edison Electric Light company struck, and the company immediately declared a lockout. About two weeks ago a large number of city lamps were suddenly extinguished, leaving a portion of the city in total darkness. Investigation disclosed the fact that the circuits had been tampered with, and frequent repetitions of the occurrence led the company to place the matter in the hands of the police. Last week during a fire two men whose actions were considered suspicious and who were unable to give a satisfactory account of themselves were placed under arrest. A man impersonated Superintendent Davis of the Edison company, and obtained the prisoners' release. Now the Edison company claims it has discovered a plot to ruin its plant. It has found witnesses, it is said, to testify that the men who had been arrested were seen tampering with the company's wires. The case is in the hands of the police, and an effort will be made to account for the frequency of the "blow-outs" which have occured so often of late.

On May 2d L. W. Davis, the superintendent of the Edison Electric company, was found guilty of attempting to coerce employes into severing their connection with labor unions, and was fined $100 and costs by Judge Gregg.

National Electric Light Association.

There will be no summer meeting of the National Electric Light association. At the last meeting of the executive committee this question was decided.

A street railroad project, recently brought forward at Vienna, Austria, provides for an electric road for that city to be modeled somewhat after that at Buda-Pesth. Detailed plans for a belt line are said to have been already prepared, and arrangements to have been made for its construction by Siemens & Halske. The current is to be furnished by the General Austrian Electric company, which has just completed its second large central station at Vienna.

Relations Between Electrical and Insurance Interests.[1]

BY JAMES A. WATERWORTH.

In discussing the relations between electrical and fire insurance interests I speak as the local representative of one species of invested capital addressing the representatives of the other. The two interests are free and equal. They are subject to the same fundamental laws, governed by the same principles, operated under the same necessary conditions With both self-preservation is the first law. The permanent prosperity of both, however, depends also on observing the laws of comity with all their kind. This is the broad general relation they hold to each other, and to every species of invested capital—the relation of independent life and independent prosperity. Invested capital cannot escape from the mutuality of the relation; it cannot violate it in any of its forms and prosper for any length of time.

To come down from general principles to the personal relations of the two interests at that point where the practical details of electrical work meet the practical details of insurance, the point of contact and of friction, let us examine the two interests. They are free; each has its own special field; neither is in any wise subordinate to the other; each is possessed of the inalienable right of self preservation. And yet they are not independent of each other. There is a common ground on which they are compelled to meet and act, a point at which there is a common interest and at which they can mutually serve or mutually injure each other. At this point the solitary law of self-preservation is inadequate, and if alone would breed strife and loss. At this point, as on every common ground of human action, the law of comity—the law under which men agree to live and thrive together—furnishes the basis of their mutual relations, and accordingly as they occupy this ground intelligently and peaceably in like proportion will they occupy it successfully. Let us look at this common ground of operation for a moment.

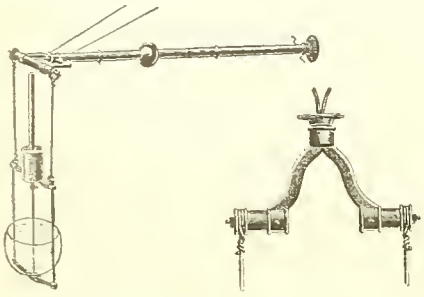
It is the lot of fire insurance companies to pay for all the improvements and experiments. This does not appear to be quite right; nevertheless public opinion seems to be agreed that this class of losses, due mainly to ignorance and in competence, should be charged up to insurance. It has been the greatest aid to progress the world has ever known, and has paid hundreds of millions to keep the industries of this country abreast of the times. It is a great, if involuntary, benefactor; but it can hardly be wondered at if under the circumstances the instinct of self-preservation is powerfully developed in the insurance interests.

Electricity was the latest novelty that presented itself to the conservative eye of insurance. The new comer did not make a favorable impression. It was a new and ubiquitous force; it was reported by its best friends to be erratic, whimsical and even dangerous. It was known that it would burn; it was said that it would kill, and it was believed that nobody knew much about it. It was popularly supposed that it took a conjunction of chemist and civil engineer to wire a building so that life and property would be safe. The coming king stepped on the stage with the reputation of an incendiary and anarchist. He claimed the right to enter every house and bring his incendiary habits with him. It was claimed that he could be permitted to enter and remain in a building with reasonable safety if—and here the electrical interests and the insurance interests met. Who was to decide under what conditions electricity could be introduced into our warehouses, factories and homes with reasonable security against setting the town on fire. Electricity brought with it a motley multitude of hangers-on and a foreign nomenclature. A new class of men, known as experts, seemed to spring like an exhalation out of all sorts of occupations—out of tinners' shops and plumbers' stores and out of boiler and engine rooms. These men knew nothing about electricity, but they soon learned to patter about volts and amperes and short circuits, and they paralyzed the boldest citizen with these and such like cabalistic expressions. They spoke with authority and claimed the right to decide what was safe and what was unsafe. In 1888 it took about three weeks to convert a mechanic into an electrical expert. The sudden growth of expert talent beat the record of Jonah's gourd. By a merciful dispensation the expert fungus perished as it had come—in a night. But while these men were contracting and doing work you may readily suppose they did not commend electricity to insurance companies as a harmless innovation. Some of the work done by them would make your hair stand on end. It is being condemned and taken out wherever found, often at great cost.

The insurance agent is rarely more than ten years in advance of the community in scientific matters, and I confess that he didn't know a bit more about electricity than the electrical expert. He wasn't so much scared by the electricity as he was by the expert talent. The insurance companies were scared, however. Whatever else they might or might not know about electricity, they knew they had to pay for it. They were right; they paid at once for the first central station in St. Louis—the Brush on Walnut street—and then they were sure that electricity was an incendiary of the first order. Do you blame them? I think that at that time, omitting a few men of technical education, there wasn't a man or boy, not even an insurance agent, in St. Louis that knew anything definite or practically useful about electricity; and much of the installation at that time was done by ignorant and incompetent men. That was the situation in the beginning, and I think the insurance companies were justified in keeping the law and practice of self-preservation well to the front. I am also free to say that I believe the situation in St. Louis was practically the situation in every city and town in the United States at the first introduction of the great modern power; it was in grossly incompetent hands. Every where throughout the

1. Abstract of a paper read before the Electric club of St Louis, April 15, 1893.

country property was being burned by imperfect electrical work. With every temptation to do it the insurance interests in St. Louis did not set themselves up as dictators to the electrical interests or take any advantage of the situation. From the start they clearly recognized and admitted. First, that they were face to face with the coming motive and illuminating power; second, that the electrical interest was clothed as fully as themselves with the instinct and right of self-preservation, and third, that the law of comity or profitable living and working together was the only law fairly applicable to the situation. The first set of rules governing electric installations was presented and recommended by a St. Louis electrician, who urged its adoption in the interests of the electrical business in St. Louis, and to restrain the conscienceless competition of ignorant and incompetent contractors. They were adopted for the mutual benefit of both interests, and the board set its best



FIGS. 2 AND 3. DILLON'S SUSPENSION BARS.

inspector to work to educate himself sufficiently to inspect the work done under the rules. These rules have been amended since by the joint action of insurance companies and electricians—your own body passing on the last edition. What has been attained in the last six years in perfection and safety of installation, in intelligence and competency of inspection, we have grown up to; we have educated ourselves up to; we have moved thereto with equal step. There is no place for the claims of small precedences in this business. The more scientific we are the humbler we shall surely be, for we know, and if we don't know our neighbors will remind us, from what depths of ignorance and with what painful effort we have climbed to the small eminence on which we stand, appropriating the discoveries of the very great investigators as fast as made, and growing great on what we fed on.

A prominent consideration determining the relations of the two interests is the authority, assumed or conceded, of making inspections. This may easily be made a ground of dissatisfaction and strained relations. But a little common sense will, I think, settle the matter. That inspection and control of electric installation is necessary and desirable, and beneficial to all, I think can not be doubted. It is certainly necessary for the insurance interests, which have to pay for all the losses caused by its dangerous defects; it is necessary for the electrical interests, if the conscientious contractor is to have a show, and if the credit of the business and the public confidence in its safety are to be maintained, it is necessary for the light and power companies who need some test of the instalations they supply, quite as much as the gas companies require a test of the gas pipes and fixtures they fill; and it is necessary for the public that it may quietly and securely enjoy the great modern boon of electric light and power. There may be and there is a question where this power of inspection and approval shall reside; with insurance, with electricians or with the public. As the greatest disaster, in case of dangerous defects, falls upon the insurance interests, as they are never quit of the risk, while the contractor is discharged of liability on payment of his bills, and as the absence of

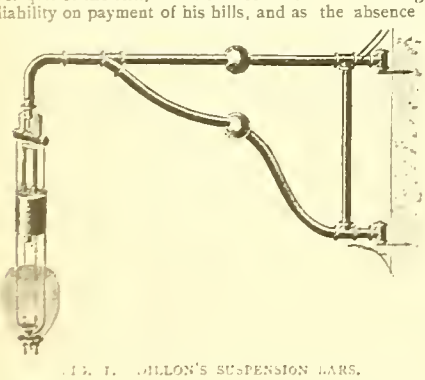


FIG. 1. DILLON'S SUSPENSION BARS.

the stimulus of direct personal interest tends to make the public official inspection superficial, the duty seems to have been wisely assumed by the insurance interest. It has most at stake. It would probably inspect on its own behalf in any case. If the general inspection be honestly administered to the benefit of all parties by this outside interest, which seeks only safety of installation, it is undoubtedly better to have it done by it, and to pay for having it done. As far as I am able to learn, there is no serious ground of complaint against inspection as at present conducted. Its rules and prices have been mutually agreed on, and the enforcement of the requirements has not been offensively made. The fruits of co-operating relations between the electrical and insurance interests in St. Louis are to be found on every hand. They are to be found first in the ability to secure the installation of any plant in the safest and most approved manner by harmonious action between us; second, in the fact which I think is apparent to all, that St. Louis is the best wired and best fitted city in the United States, and third, is not this association itself, and this meeting, one of the fruits of harmonious relations? The survival of the best and strongest elements in the electrical business; the dying out of the mushroom expert; the training and education of the men who had the mental and moral powers fitting them to live—all this I think is attributable in part to the high standard of requirements adopted for electrical work and the harmonious relations that secured its application. A curious proof of the thorough-going nature of the inspections in St. Louis was furnished in connection with a job done by a Chicago contractor in one of our largest stores. The requirements were well understood, and the understanding was positive, that the concealed work was not to be covered till it was inspected. But the inspector found the concealed work boxed up and the walls painted and decorated in fine style before the work had been inspected. The certificate was refused. The opening was to take place in a day or two. No threats nor objurgations of the Chicago man, who had never heard of such a high-handed proceeding in his life, nor even the entreaty of the merchant, the beauty of whose opening would be materially marred by tearing open the walls, could extort the certificate. We induced the merchant to stand firm and refuse payment till the certificate should be issued. The contractor was brought back from Chicago, the boxing was stripped off, and an incomplete, unsafe and skamped job stood revealed. It cost the fellow three days' work to make it right. When he got his certificate he swore he would not work in the town for $500 a month.

Whether electricity is a fire hazard when installed with all safeguards science can suggest is a question on which the two interests may not always agree; but I will say that in practice it has been decided in St. Louis in favor of the subtle fluid, which is admitted as an illuminator and as a power without charge for it as such. This would seem to remove the matter from the ground of a vexed question, and free the discussion of our relations from that issue. Undoubtedly from the insurance point of view the accumulation of many new and intense potencies, both of light and power and material—electricity among the rest—is forcing up the loss ratio of the country and slowly increasing the rates of insurance. There is none

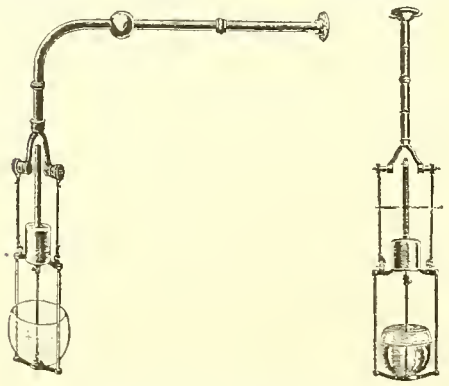


FIG. 4. DILLON'S SUSPENSION BARS.

of us wise enough to put his finger on the amount, proportion or nature of this increase of the fire loss due to the universal use of electricity. Personally, I believe that in all its uses, when properly installed, it is an improvement over that which it has displaced. The sum of all these influences is one of the marks and concomitants of our present progress and it would be more profitable to adjust ourselves to it than to protest against it. On this score insurance stands in precisely the same relation to the electrical interests that it does to all other interests and elements which enter into and create our fiery experience.

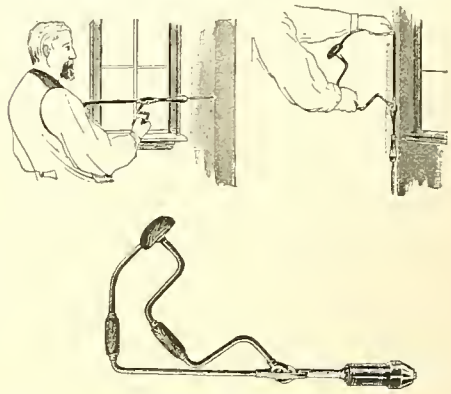
I am not competent, even at this late day, to talk electric talk to you, nor would I attempt it in this presence if I were. I know I know much less about electricity than I knew I knew five years ago. Probably some of you have had the same experience. It offers the vastest and richest field now open to human investigation; in its unexplored tracts it contains the largest elements of power, the mightiest factors of material prosperity, convenience, comfort and civilization left for the enjoyment of the last ages; in its domain man will achieve wonders of discovery, and by its aid exhibit marvels of power beside which all that the puny past can show will shrink into insignificance. The world will become a neighborhood, and the unity of the race will be accomplished. Into these things I cannot expect to enter save by faith and reasonable expectation. But I can, from the height on which we now stand and with the prospect now within our ken, see enough to justify me in protesting against the paltry and narrow suggestion that, for any vain dream of temporary advantage or visionary profit, it would be wise or necessary that the great interests under consideration should adopt the law of self-preservation as the sole rule to govern their relations toward each other, and abandon that higher law of comity and mutual help under which they have hitherto lived and thrived together.

Automatic Electric or Gas Lighter.

The accompanying illustration shows an automatic door spring electric lighter for gas and electricity, which has recently been put upon the market by the New York Electrical & Development company, of 281 Madison street, New York. It is similar to an ordinary door or window spring, and when the door is opened the automatic spring electric lighter turns on the electric light or gas light, as the case may be. The light is extinguished by opening the door the second time, and not by closing the door on entering, as might be supposed. On entering a vault, a refrigerator, a closet, or a room of any sort, the act of opening the door thereto turns on the light, the light continuing burning after the door has been closed and while the person is still within. Then on opening the door again to leave the room, the light is extinguished.

Dillon's Suspension Bars.

Central station men will be interested in the accompanying cuts representing a lot of very handy electric light fix-

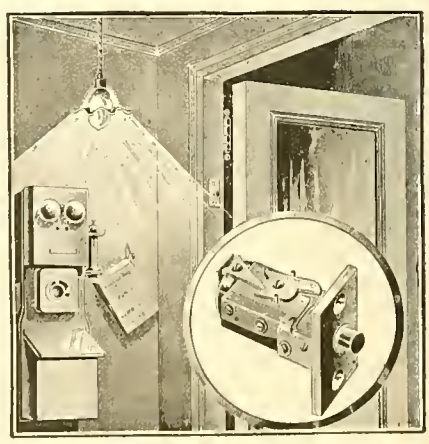


AMIDON'S CORNER BRACE.

tures. These suspension bars, as they are called by their designer, Thomas Dillon of Indianapolis, have a number of valuable features. They are made of one or one and one-quarter inch pipe and are intended to support arc lamps or groups of incandescent lights. By the use of these fixtures the wires may be kept out of sight, and with one of these suspension bars, according to Mr. Dillon, no more falling lamps are possible. Referring to the cuts. Fig. 1 represents a swinging crane for high lamp service, that is, for use with lamps in opera houses, hotels, etc. Figs. 2 and 3 show respectively the Dillon outside bar for general use and the yoke for suspension bar or for low ceilings and numerous other purposes. Fig. 4 represents another style of outside bar that is adapted especially for places where awnings interfere. Fig. 5 shows the Dillon inside suspension bar. This last mentioned style of fixture is highly ornamental, being made of either nickel, brass or iron. It should be mentioned in connection with these bars that a recent improvement has been made by the insertion of the switch on the bars just above the lamp. These suspension bars are handled by the Dillon Mast Arm company, Indianapolis, Ind.

Amidon's Corner Brace.

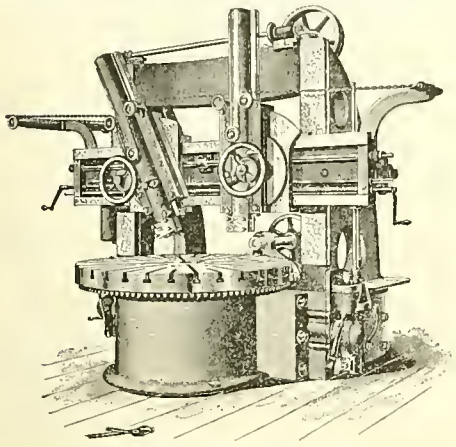
The accompanying cuts represent Amidon's corner brace and show the applications in which this tool is particularly useful. Wiremen will appreciate the features of this brace. The Amidon Tool corporation of Buffalo, N. Y.,



AUTOMATIC ELECTRIC OR GAS LIGHTER.

its manufacturer, claims that this brace bores fully ten to twenty times as fast as the ratchet brace, as the movement is round and round. It bores also very much easier, for two reasons: It is easier to turn round and round than back and forth, and the pressure coming on the arm of the brace instead of the sweep itself more power is gained. For heavy work or boring into hard wood, but especially for boring overhead, which is very severe work, either in a corner or in the clear, the superiority of the corner brace is apparent in the advantage gained by the pressure on the arm. In boring in the wall at the floor this advantage is highly appreciable,

as the foot can be used against the arm with good effect. The corner brace, however, is not confined to work in the corner or against a wall, but owing to the advantage just mentioned in the arm it will do much easier and just as good work in the clear as an ordinary brace. It will bore close into a corner; the ratchet brace, owing to the head, will not bore a straight hole within an inch and a half of the corner. In removing the bit and clearing the hole time is also saved, as the ratchet brace must be worked back and forth as in boring. In hardwood boring the bit is often loosened from the ratchet brace in the backward movement which cannot be the case with the corner brace. With the corner brace a straighter hole can be bored than with any other brace, as the eye is easily guided by the straight



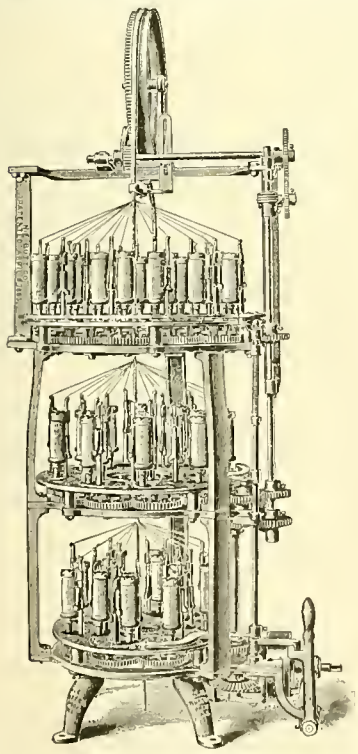
NEW BORING AND TURNING MILL.

rod, at the end of which the bit is held. The corner brace will not cripple by springing (bending) the sweep from heavy work, as the pressure, being on the arm, bears directly down upon the bit and not on the sweep.

New Boring and Turning Mill.

The accompanying cut illustrates a new boring and turning mill manufactured by the Bridgeport Tool Works, Bridgeport, Conn. It combines all the essential features of smaller mills of the same type and contains some new ideas which are not embodied in other mills.

The capacity of the mill is 62 inches in diameter and 42

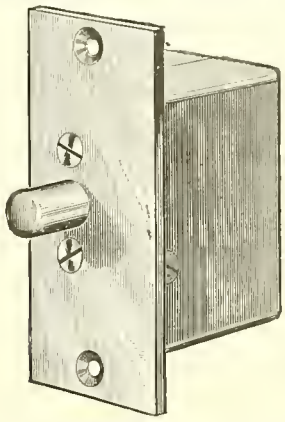


TRIPLE BRAIDING MACHINE.

inches in height. The table is 58 inches in diameter, is powerfully geared and has 15 changes of speed. The heads are constructed so that either one may be brought to the center, and can be set at any angle. They carry the tool bars, which have a movement of 30 inches. Each head has an entirely independent feed in any direction. The feeds are all positive and range from 3-64 to 3-4 of an inch horizontally and from 1-64 to 3-8 of an inch in angular and vertical directions. The weight of the machine is 20,500 pounds and it is self-contained.

Triple Braiding Machine.

The accompanying cut shows the New England Butt company's improved triple braiding machine. This is a large gear braider, in triple form, 16, 20 and 24 strand, with a 14 inch wheel take-up. It is made in the following combinations: Twelve and 16 and 20 strand, 12 and 16 and 24 strand, 16 and 16 and 16 strand, 16 and 20 and 24

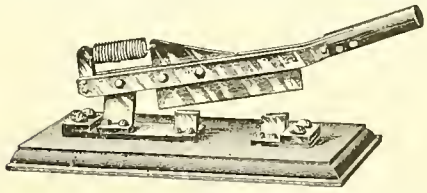


C. & S. FLUSH AUTOMATIC SWITCH.

strand, 16 and 24 and 24 strand, 24 and 28 and 36 strand. These machines can be supplied with iron scored rolls, if desired. The New England Butt company of Providence, which makes these machines, has excellent facilities to meet the exacting requirements of the makers of insulated wire in a most satisfactory manner. Braiding and cable covering machines made by this concern may be found in wire covering factories throughout the country. Many of these machines are made after special designs and for the performance of special work which could not be economically turned out without them.

The "C-S" Flush Automatic Switch.

The increase in the use of the incandescent electric light has developed a general inclination to adapt it to many special purposes. A recent addition to

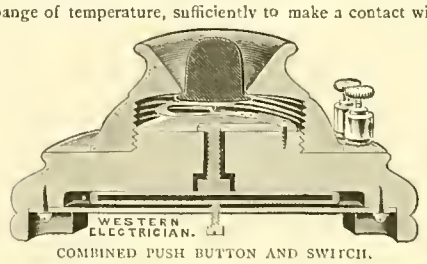


SNAP KNIFE SWITCH.

this style of goods is a flush automatic switch for use in bath rooms, dark closets, etc. sold by the Cutter Electrical Manufacturing company of Philadelphia. This switch is set flush in the rabbet of a door jamb in a manner similar to the familiar burglar alarm spring, and its action is strictly automatic. Every time the door is opened the light is turned on, and every time the door is closed it is turned off. Nothing can be disarranged by the accidental opening or closing of the door, at the wrong time, consequently it requires no attention or adjustment whatever after it is once set up. This switch may also serve as an efficient burglar alarm, as an intruder is at once confronted by a bright light upon opening a door. The cut presented of this article shows the switch complete in its fire and moisture proof casing.

Combined Push Button and Thermostat.

Charles E. Egan, of Chicago, has recently perfected a push button and thermostat combined which promises to meet with general approval. In the cut is shown a sectional view of the device. By means of two circular disks, completely sealed at their edges, an air chamber between them is secured, which expands and contracts with any change of temperature, sufficiently to make a contact with

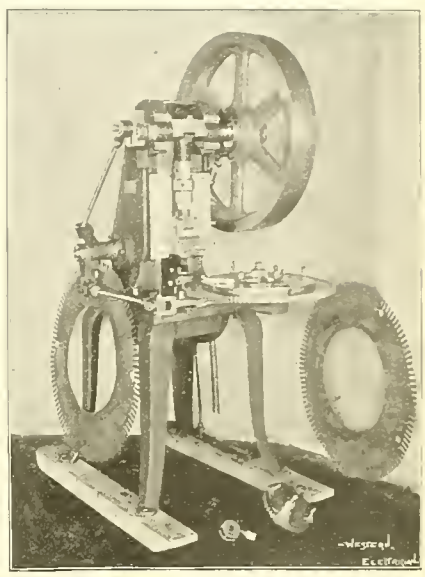


COMBINED PUSH BUTTON AND SWITCH.

an adjusting screw, which closes the circuit, thus giving the alarm. The circuit can also be closed by pressing the button, which in no way interferes with the workings of the thermostat attachment. The adjusting screw is readily operated from beneath, and enables a quick and easy adjustment to be made for any desirable degree of heat. In its construction, no fusible material of any kind is introduced, which must be replaced after use, or even a trial, and yet it is capable of such fine adjustment that it can be "set off" by the breath. The whole is finely finished, and in size is about as large as ordinary push buttons.

Bliss Press with Automatic Index Feed.

This machine is especially designed for cutting the notches in the circumference of armature disks for electric motors and generators. The disk is securely guided and clamped on the revolving plate, which at its lower edge has as many teeth as there are notches in the circumference of the disk. The operator starts the machine by putting his foot on the treadle, causing the disk to revolve one notch after each stroke of cutting punch. When the last notch is cut he releases the treadle, which causes the machine to stop ready for the introduction of another disk. The machine is adjustable in diameter from 10 inches to



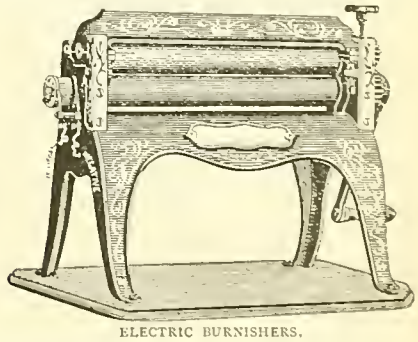
BLISS PRESS WITH AUTOMATIC INDEX FEED.

34 inches and more if required. The weight of the machine is about 1,700 pounds.

There are a number of these in use by large electric companies. They are manufactured by the E. W. Bliss company, 14 John street, Brooklyn, N. Y.

A Snap Knife Switch.

To meet the demand for a good snap knife switch that will have a positive and quick break action without complication, the C. & H. switch has been placed on the market by Cutler & Hammer, Chicago. This switch, which is illustrated in the accompanying cut, shows a length of break



ELECTRIC BURNISHERS.

greater than in most switches now on the market, which makes it particularly desirable for high tension circuits. As will be noticed, the design is extremely simple. It is made both dipped and polished; single, double or triple pole; is mounted on wood or slate bases, and has capacity from 15 to 1,000 amperes. It will undoubtedly meet with a large sale.

Electric Burnishers.

In the accompanying cut is illustrated the electric burnisher for photographic work, which is placed on the market by the Wales Manufacturing company of Syracuse, N. Y. In this machine the polishing roller has a resistance or heating coil suspended. A commercial current or a storage battery will heat the roller; therefore it can be set up in any place where electricity can be had. There is no limit to the amount of heat, and it is put under perfect control by means of a rheostat or switch at the end. Among the advantages claimed for this special style of

apparatus is the fact that absolutely uniform heat is secured, and that the machine can be heated in less than half the time required by other processes. The electric burnishers possess all the advantages of the oil machines and are practical and economical. The cost of running an electric machine is light, since current can be secured from a commercial circuit or a storage battery. Any desired amount of heat can be obtained in three minutes. Machines can be constructed for any current stated.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 6.—Far overriding in interest every other subject discussed in electrical circles here this week has been the disastrous state of the stock market, and especially its influence on the fortunes of the General Electric company. On Wednesday the market was in a state of virtual panic. There were fluctuations of 2 or 3 points in many stocks between sales. Enforced liquidations were going on everywhere. Intrinsic values were lost sight of. Hardly a single stock on the list showed firmness, and the air was full of talk about impending failures. A prominent financial journal, in its Thursday issue, in commenting on the situation, said: "General Electric and Lead are the most affected. Lead is at the lowest price it ever sold, and so is General Electric. There are more or less vague hints that both companies are getting ready to follow the Cordage example and deluge the street with new securities." On Friday another Wall Street authority came out in a very flat-footed way on the subject: "Where the pinch is severest is with such companies as the General Electric trust and other over-capitalized concerns, whose assets consist of cats and dogs, with residences scattered all over the globe. All the trusts are a sale. They want money and they can't get it. General Electric stock has not taken its punishment yet. There is liquidation to come there. It may be delayed, but it is certain." Within a few hours of the publication of this startling prophecy the General Electric stock passed through an experience that has been seldom recorded in the fluctuations of Wall street. During the preceding Monday, when it started at 98¼, the stock dropped 3¼ points, and it closed on Wednesday at 88¼ and on Thursday at 79½. On Friday morning the air was filled with alarming rumors of pending failures, and shortly before 11 o'clock the suspension of S. V. White was announced amid great excitement. The news seemed to set the street crazy, and an avalanche of stock was showered on the market. By noon the irresistible tide of liquidation had carried General Electric down to 58, and the suspense as to what would next happen became intense. The stock, however, soon showed that it had active support in a quarter that is a tower of strength on the street, and at the close of the day had swung right back to 79½, nearly 22 points. The situation elicited from President Coffin a special dispatch, in which he said: "The General Electric has no pressing liabilities, no call loans outstanding, and has recently paid $2,000,000 of its obligations. The collections are not at all slow, and the company's factories are as crowded as ever to keep up with the orders." This was followed by a statement by John S. Wise, counsel of the General Electric company, to the effect that "the company has inventories, work in progress and stocks and bonds at a valuation, said to be conservative, in excess of $34,000,000, as shown in detail in the annual report, and the volume of the company's business is greater and its cash sales are much larger than ever before." These statements, even taken in conjunction with the firmer state of the market, have not had the effect of removing a sense of uncertainty as to the outcome of the next few days, and the developments of the ensuing week will be watched with not a little anxiety.

The discontent which has for some time been brewing among the linemen in Brooklyn has culminated in a general strike, and throughout the telephone, electric light and trolley railroad services $3 a day is demanded instead of $2.50, as formerly. The only company to accede to the workmen's demands is the Atlantic Avenue Railroad company, which has a great deal of construction work on its hands, and would be subjected to most serious loss if its operations were in any way arrested. The strike has been much strengthened by the co-operative action of the linemen of the New York & New Jersey Telephone company, which is already suffering seriously from the movement. It is said that complaints of poor telephone service are coming in at the rate of forty per day; only eight men are left to do the work of fifty, and quite a number of the subscribers are threatening to break their agreements if the service is not improved. It is regarded as possible that a general strike may be ordered throughout Hudson county. The Brotherhood of Electrical Workers claims to have about $14,000 in its treasury.

A meeting of the Rapid Transit commission was held yesterday, and another stage in the one-sided game that is being played by the Manhattan Elevated Railroad company and the city was entered. All the fencing and delays that have been inseparable from the negotiations for the provision of comfortable and efficient travel for the people of New York point to one result, that, in the long run, the citizens of New York will have to take whatever the Manhattan Railroad company chooses to give them. It seems hardly conceivable that any civilized community will put up with the frightful discomfort of daily travel that now obtains on the elevated roads. The inefficiency of the present capabilities of the Sixth avenue line was never more completely shown than in the transportation of the crowds of passengers that journeyed up-town to witness the illumination of the warships in the river. The stairs leading to the different stations on the line were in many cases so jammed that great numbers of people gave up the attempt to reach the platform. At some stations the crowd on the platform was so great that it was with the utmost difficulty that passengers could leave the car. The guards of the train were powerless. Most of them were forced to sit or stand on the brake-handles between the cars. They could neither open or shut the gates. Bad as was the journey up-town, the return was infinitely worse, and it was nearly midnight when the last of the weary and rain-beaten travelers were able to find a seat in the cars. At yesterday's meeting the railroad company presented an answer to the proposition which has been made by the commission for additional privileges. The company shows that the cost of constructing the extensions and new tracks proposed by the commission will cost $23,000,000. The company assures the commission of its desire to extend the lines, but objects to the proposed 5 per cent. tax on net earnings and presents these counter propositions: First, the Legislature has already settled what the road shall pay the city; second, that so long as $22,000,000 will be expended in extensions the advantage will be on the side of the city, as the company will have to pay the tax on this. The 5 per cent. arrangement is therefore not necessary. The company finally offers to pay 3 per cent. on the whole, or 5 per cent. on the new extension. The summing up of the answer sets forth that "in deference to the expression of the commission that the city should be compensated, the company is willing, although it deems it unjust, to agree to pay the city as aforesaid."

The announcement last week of the failure of Erastus Wiman, who is well known from the prominent part he has taken in the development of the resources of Staten Island, and especially in the providing of electric light for the community with which his interests have been so largely connected, occasioned but little surprise. His liabilities were estimated at anything over $600,000. It was known for some time that he was financially embarrassed, and while it is to be deplored that a man so prominent in the commerce of the city should meet with disaster, the failure is another indication of the distressed conditions now prevailing in commercial circles not only in this city but also in the South and West.

At length the cable cars are to begin to run down town. The new service will be in use as far south as Houston street. The cable is as yet running very stiffly, but is giving less trouble every day. Brakemen and conductors are being "broken in" on the cable cars now in use between Fifty-ninth street and Fiftieth street, and in a few days several additional cars will arrive for the extended service.

The American District Telegraph company has declared a quarterly dividend of 1¼ per cent., payable May 29th.

The Edison Electric Illuminating company of New York is now prepared to waive the 90 days' notice from bondholders, as required by the deed of trust, and to issue stock in exchange for the first mortgage convertible bonds.

W. F. O.

PERSONAL.

J. E. Hudson, president of the American Bell Telephone company, was in Chicago last week.

General E. S. Greeley, president of the E. S. Greeley & Co., New York, was in Chicago last week.

F. A. Scheffler resigned his position of general superintendent of the Brush company of Cleveland, O., April 1st, and has accepted the position of general sales agent of the Stirling company, manufacturers of the Stirling water tube boiler, with office at 74 Cortlandt street, New York.

The friends of Samuel Cochrane, jr., of Chicago, will be gratified to learn that hereafter he will be associated as assistant with Mr. Hoover, manager of the Standard Paint company 871 Rookery building. The rapidly increasing business of the company renders such an office necessary.

NEW INCORPORATIONS.

Electric Appliance corporation, Burlington, Kas.; to manufacture and sell electric appliances and felt soles.

Electric Light company, Ottawa, O; capital stock, $30,000; furnishing electric light, heat and power; N. E. Matthews, Ottawa, O.

Joplin City Light & Fuel company, Joplin, Mo.; capital stock, $150,000; to deal in fuels and manufacture gas and electricity; C. H. Malin, Joplin, Mo.

Canton General Electric Light company, Canton, S. D.; capital stock, $25,000; supplying electric light, heat and power, etc.; C. E. Judd, Canton, S. D.

Columbian Electrical Works company, Denver, Colo.; capital stock, $50,000; buying, selling and manufacturing all kinds of electrical machinery and goods.

Richmond Electric Light company, Richmond, Mo.; capital stock, $18,000; operating electric light plant; Richmond Electric Light company, Richmond, Mo.

Des Moines Electric company, Des Moines, Ia.; capital stock, $600,000; to establish, maintain and operate an electric water power plant; Lowry W. Goode, Des Moines, Ia.

Post-Glover Electric company, Cincinnati, O.; capital stock, $50,000; dealing in and manufacturing electrical and railway supplies, etc.; Richard P. Ernst, Cincinnati, O.

Mount Vernon Electric Light company, Mount Vernon, Ill.; capital stock, $20,000; to furnish electric lighting for Mount Vernon; Mount Vernon Electric Light company, Mount Vernon, Ill.

Waring Electric company, Hartford, Conn.; capital stock, $5,000; to buy, make, use and sell apparatus in connection with which electricity is used, etc.; E. D. Robbins, Wethersfield, Conn.

Wilkesbarre & East Side Railway company, Wilkesbarre, Pa.; capital stock, $50,000; constructing and operating an electric railway in Wilkesbarre, Pa; William Myers, Harrisburg, Pa.

Abatis Electric Manufacturing company, Chicago, Ill.; capital stock, $50,000; to manufacture and sell electric appliances, supplies, etc.; E. O. Partridge, 356 Rookery, Chicago, Ill.

Gallitzin Electric Light company, Gallitzin, Pa; capital stock, $20,000; supplying light to the public by electricity at Gallitzin, Cambria county, Pa.; Gallitzin Electric Light company, Gallitzin, Pa.

Luzerne, Dallas & Harveys Lake Railway company, Luzerne, Pa.; capital stock, $100,000; constructing and operating an electric railway in Luzerne county, Pa.; J. B. Reynolds, Wilkesbarre, Pa.

Media, Middletown, Aston & Chester Electric Railway company, Media, Pa.; capital stock, $30,000; constructing and operating an electric railway in Delaware county, Pa.; Edmund Jones, Chester, Pa.

Western Electric Power & Light company, Topeka, Kas., and El Reno, Okla.; capital stock, $50,000; to build and operate electric plants for manufacturing and selling electric power and light.

Parkersburg & Oxford Electric Railway company, Mifflintown, Pa.; capital stock, $100,000; constructing and operating an electric railway in Chester county, Pa.; Robert McMeen, Mifflintown, Pa.

Edison Electric Light & Power company, Meridian, Miss.; capital stock, $50,000; to conduct a general electric light and power business in the city of Meridian; C. W. Gallagher, Meridian, Miss.

St. Joseph Traction & Lighting company, St. Joseph, Mo.; capital stock, $1,700,000; operating cars by means of cable, electricity, horses, and dealing in machinery; Amick & Brown, St. Joseph, Mo.

Messer Elastic Rotator company, Philadelphia, Pa; capital stock, $10,000; to manufacture and sell machinery, wheels and mechanical appliances; Alfred S. Miller, 313 Drexel building, Philadelphia, Pa.

Wirt Laboratory company, Chicago, Ill.; capital stock, $10,000; to manufacture and deal in patents on articles pertaining to electrical business; Francis W. Parker, 1007 Opera House building, Chicago, Ill.

Townsend Gas & Electric company, Seattle, Wash.; capital stock, $150,000; to construct, maintain and operate light, heat and power plants, telephones, water works, etc.; W. J. Grambs, Seattle, Wash.

Hanover Light, Heat & Power company, Hanover, Pa.; capital stock, $25,000; supplying heat, light and power by means of electricity at the borough of Hanover, York county, Pa.; C. E. Ehrehart, Hanover, Pa.

Economy Electric company, Chicago, Ill.; capital stock, $1,500,000; to build, own, operate, lease, buy and sell electrical machinery and appliances; Economy Electric company, 913 Pontiac building, Chicago, Ill.

Chicago Insulated Wire company, Des Moines, Ia.; capital stock, $200,000; to manufacture, buy, sell and deal in all kinds of metals, appliances, fixtures, etc., used in electric lighting; C. E. Hunn, Des Moines, Ia.

Frisbie Elevator & Manufacturing company, New Haven, Conn.; capital stock, $70,000; to manufacture, buy, sell, own and deal in elevators and machinery, electrical devices, etc.; W. M. Frisbie, New Haven, Conn.

Royal Arc Electric company, Plainfield, N. J; capital stock, $1,000,000; to manufacture, operate and deal in

apparatus for producing and transmitting light by electric means, etc.; Frederick C. Marsh, Elizabeth, N. J.

Williams Bay Hotel company, Chicago, Ill.; capital stock, $150,000; to manage and operate hotel, electric light and gas plant, water works, livery stables, etc.; Frank E. Baker, 161 La Salle street, Chicago, Ill.

Chicago Dock & Investment company (incorporated in Virginia), Chicago, Ill.; capital stock, $12,000,000; to buy, own and sell machinery and merchandise, motive power, water works, etc., elevators, docks, stock, yards, etc.

Pittsburg, Greensburg & Latrobe Electric Railroad company, Tyrone, Pa.; capital stock, $1,000,000; constructing and operating an electric railway in Westmoreland and Allegheny counties, Pa.; Stevens & Owens, Tyrone, Pa.

Northwestern Water & Light company, Le Mars, Ia.; capital stock, $200,000; erecting, purchasing, maintaining and operating water works and electric light and power plant; Northwest Water & Light company, Le Mars, Ia.

Frankford, Bridesburg & East Fairmount Park Railway company, Philadelphia, Pa.; capital stock, $78,000; constructing and operating an electric railway in Philadelphia, Pa.; John G. Lamb, 210 South Fourth street, Philadelphia, Pa.

Philadelphia & Fox Chase Passenger Railway company, Philadelphia, Pa.; capital stock, $75,000; constructing and operating an electric railway in Philadelphia, Pa.; Henry S. McCaffrey, 2700 Germantown avenue, Philadelphia, Pa.

Second Avenue Traction company, Pittsburg, Pa.; capital stock, $1,000,000; constructing and operating motors and cables, etc., for supplying motive power to passenger railways; Geo. C. Wilson, 507 Times building, Philadelphia, Pa.

Bellaire, Bridgeport & Martin's Ferry Street Railway company, Bridgeport, O.; capital stock, $250,000; constructing, maintaining and operating electric street railway from Bellaire, through Bridgeport, to Martin's Ferry, O.; Thomas W. Sanderson, Youngstown, O.

Youngstown & Canfield Electric Railway, Light & Power company, Youngstown, O.; capital stock, $65,000; constructing and operating electric railway between Youngstown and Canfield, furnishing electric light and power, etc.; J. Calvin Ewing, Youngstown, O.

Martinsville Street Railway company, Martinsville, Ind.; capital stock, $25,000; constructing, owning and maintaining a street railroad upon each and every street, alley and highway of Martinsville, and the use of electricity and electric motors as a motive power thereon.

Electrical Fire Works & Construction company, Chicago, Ill.; capital stock, $100,000; to manufacture and deal in electrical fire works and machinery, electrical apparatus, appliances, machinery and devices, and operate same, and do general electrical construction business; Ball & Barrett, 1504 Unity building, Chicago, Ill.

ELECTRIC LIGHTING.

Glasgow, Ky., is talking of an electric light plant.

An electric light and water works plant is to be put in at Ontonagon, Wis.

The Massachusetts Reformatory in Boston will have a $12,000 electric lighting plant.

The Edison Electric Power & Illuminating company will enlarge its plant at River Point, R. I.

William Spiers has applied for a franchise to establish an electric light plant at Washington, N. J.

The Thomson-Houston Electric Light company intends to erect an electric light plant at Newport, Ky.

A proposition is to be submitted to the citizens of Forrest, Ill., to authorize the purchase of an electric light plant.

Over forty miles of wire will be used on board each of the two new mammoth Cunard steamships, Campania and Lucania. Each ship is to have a powerful search-light and about 1,350 incandescent 16 candle power electric lamps.

The electric light is gradually making its way into the most remote districts in Ireland. In the County Donegal, in the extreme north, an installation is being put down at the residence of J. Watt, Esq., of Romelton. It is intended to use an oil engine of the Hornsby-Akroyd type, directly connected to a Norwich compound dynamo. A set of accumulators of the E. P. S. type is included.

ELECTRIC RAILWAYS.

It is proposed to establish an electric tramway between Atami and Odawara, Japan.

The street car company of Yuba City, Cal., contemplates an extension of its lines.

The street car system of New Albany, Ky., is being furnished with a trolley system and will soon be in running order.

An extension of ten miles is soon to be added to the tracks of the Consumers' Electric Light & Railway company of Tampa, Fla.

The street railway company of Aurora, Ill., has been granted permission to extend and operate its lines on several streets of the city.

It is proposed to build an electric car line from Toledo, O., to the bridge over Ten Mile creek at Cramers with a view of extending it to Monroe and Detroit.

The Chicago & Evanston electric railway is for the most part completed and ready to begin operations, but it will probably not be possible to run cars until in the neighborhood of June 1st. The reason for the delay is city work on sewers and other street excavations.

TRADE NEWS.

The Chicago office of the Hill Clutch Works of Cleveland, O., will hereafter be 850 Rookery.

The Consolidated Electric Storage company, formerly of 120 Broadway, New York, will hereafter be located at the Edison building, 44 Broad street, New York.

The C. & C. Electric Motor company, New York, in addition to its branch offices in Chicago, Boston and Portland, Oregon, and a dozen other cities throughout the United States, on May 1st opened another in Philadelphia. The new office is under the charge of Geo. H. S. Young.

The Commercial Electric company of Indianapolis has just issued a catalogue describing its dynamos, motors and power generators. The catalogue is profusely illustrated. These machines have already been described in the WESTERN ELECTRICIAN and their special features are well known to the trade.

The Redding Electric company of Boston, Mass., manufacturer of electrical specialties, has recently issued an illustrated and descriptive catalogue of its lines of snap switches, cut-outs, push-buttons, etc. The book is well illustrated, is concise in descriptions and presents an attractive appearance.

Clark & Marshall, dealers in electrical specialties, 345 Rookery building, Chicago, are representing the Boston Incandescent Lamp company. This company claims to repair burned-out lamps in a manner which makes them as good as when first made. Clark & Marshall also have on hand a large line of electrical specialties, and are prepared at all times to bring them to the attention of the trade.

Thomas Dillon of Indianapolis, Ind., is hard at work introducing an improved fan for summer restaurant service. Mr. Dillon believes in mechanical refinements, and is now fitting up all his fans with ball bearings. By this improvement the saving in money for monthly power bills is considerable—at least the Indianapolitans are now testifying to this effect.

Word has been received from Louis Nahm, secretary and treasurer of the American Electric Manufacturing company, manufacturer of incandescent lamps, St. Louis, Mo., that the company has resumed its business after having doubled its capacity and is turning out a better grade of lamps than ever. The American incandescent lamp has an established reputation that makes it unnecessary to dwell upon its merits.

The Ansonia Electric company, Chicago, announces that it is now ready to take orders for the Sunbeam incandescent lamp. At the present time the factory output will not permit of the immediate shipment of all orders as fast as they are being received, but the company hopes shortly to find itself in position to fill all orders promptly. This lamp, the company claims, has been thoroughly tested and will be found entirely satisfactory.

The magnificent temple erected by the disciples of Brigham Young at Salt Lake City, Utah, is thoroughly equipped with all the latest devices for electric lighting. E. G. Holding, of Salt Lake City, installed the electrical work, and all the devices were manufactured by the Bryant Electric company, of Bridgeport, Conn. The workmanship throughout is fine, and Mr. Holding can certainly feel proud of portion of the his work.

In connection with the opening of the World's Fair by electricity much attention was attracted by the large single Ajax cell delivered by the Ansonia Electric company of Chicago to the exposition authorities for this purpose. This giant battery is 30 inches high and 12 inches in diameter. Several ordinary-sized cells of Ajax battery furnished a portion of the current used for the circuit operated by the president when he set the Allis engine in motion by electricity.

The General Incandescent Arc Light company, New York, has taken the agency in the United States and Canada for the arc light carbons and carbon brushes manufactured by Fabrik Elektrischer Beleuchtungskohlen in Nurnberg, Actiengesellschaft vormals Ch. Schmelzer. This will make it possible for these high grade carbons to be purchased at prices comparing favorably with domestic carbons, which are recognized as inferior in some respects to the imported grade.

Messrs Bergtheil and Young, of 13 Walbrook, London, E. C., electrical engineers, inventors, etc., are seeking American electrical specialties for introduction into the European markets. The firm is said to bold a high rank in England. Arthur Bergtheil, the senior member, is expected to arrive in this country this week for a brief stay, and it is his intention to take in the World's Fair, and during his sojourn to visit the larger electrical firms and ascertain what specialties there are of value to the English market.

Wm. Hubbard & Co., representing the Elgin telephone, have just removed from 116 La Salle street, Chicago, to suite 55 Merchant's building, 92-94 La Salle street, where they now have increased facilities for their rapidly growing business. Mr. Hubbard, it should be stated, is making quite an extensive exhibit at the World's Fair. His space is in the southeastern portion of the electricity building, in the gallery. Mr. Hubbard's well known acoustic telephone has been very much improved and he states that a number of important patents have been recently taken out on new features of line construction.

The Mica Insulator company, 218 Water street, New York, reports increased sales for its micanite insulators. Besides the leading electrical manufacturers in this country and abroad, who have adopted this method of handling mica, it is being used by electrical street railway companies for repairing their motors and generators. Taking into consideration the great saving in cost over using mica in the regular sheet form, it may pay any one wishing the best insulator to investigate micanite.

The Emerson Electric Manufacturing company, St. Louis, Mo., has issued an illustrated catalogue and price list of its large assortment of Meston alternating current motors. Particularly interesting is the display of fan motors presented by this company, which is complete and tasteful. Another specialty illustrated is the alternating current dental motor. The alternating current sewing machine motor receives a large share of attention and presents a number of novel features.

One of the most complete establishments for the manufacture of bicycles in the country is the factory of the Stokes Manufacturing company, Carroll avenue, Chicago, where the "Sterling" is made. The factory is turning out 25 complete machines per day and is still behind in its orders. Special machinery is employed and in all departments the greatest care is taken to produce only perfect parts. The general office and salesrooms of this company are situated at 293 Wabash avenue.

It was announced some time ago that the Western Electric company had filed a bill for an injunction against the Potomac Electric company of Georgetown, D. C., and also that the company's indebtedness was over $50,000 and largely in excess of its capital stock. As a matter of justice to the Potomac Electric company it should be stated that its troubles with the Western Electric company have been satisfactorily settled and that there is no bill for an injunction against the company, filed by the Western Electric company.

Perhaps no manufacturers of electrical machinery and specialties ever sprang into existence under more favorable auspices than the Muncie Electrical Works, Muncie, Ind. It has been before the public only about six months, but already it finds itself unable to meet the orders that are constantly pouring in. It has at the present time orders that it will be impossible to fill during the next six months. This company handles a particularly fine line of dynamos, motors, power generators, etc., and deals in arc and incandescent lighting apparatus extensively.

Repeated indorsements are constantly being received by the American Silk Manufacturing company of Philadelphia, of its patent silk machine wipers. As a matter of economy and safety the company claims no engine room should be without them. They have been recommended and indorsed by the boards of fire underwriters in St. Louis and Philadelphia, which said of them that they fully sustained the claims made for them. The success of a wiper, for which it is claimed that it is made of the finest material for polishing in existence, that it costs only half as much as common waste, that by its use there is no danger from spontaneous combustion, and that it contains no fibers to get into oil cups, is certain.

C. E. Woodruff & Co., successors to the Globe Supply company of Chicago, are now situated in their quarters at 235 Lake street, Chicago. This firm is the western agent for a number of electrical specialties, and, beside carrying a full line of electrical supplies, is ready to equip general stations in all branches upon a moment's notice. C. E. Woodruff, at the head of the firm, has been well and favorably known in the wire and general supply business for the last ten years. He is associated with Andrew Shillinglaw and J. F. Figel, the former for 13 years superintendent of the electrical department of Armour & Co., and the latter for a long time connected with the rubber and leather business.

The Menominee Electric & Mechanical company, Menominee, Mich., is presenting two very satisfactory fan motors for direct currents to the public. Type No. 1 is designed for direct current of any voltage, and includes a seven and one-half inch fan and lamp socket. No. 2 has three different speeds, regulated by switch on top of motor and is designed for direct current of 100 or 110 volts. It carries either 12 or 16 inch fans. The same company has a good switch in its spiral spring lever snap switch which has been so successfully introduced. It is substantially made, properly porportioned and mounted on slate base. The spring causes an instantaneous break across the lines of contact simultaneously and prevents arcing.

BUSINESS.

The Ball Engine company, Erie, Pa., has closed an order with H. F. Watson, paper manufacturer, Erie, Pa., for a 500 horse power Gross compound engine.

The Bradford Electric Light company, Bradford, Pa., has recently closed a contract with the Ball Engine company, Erie, Pa., for a 200 horse power single cylinder engine.

P. C. Ackermann, manager of the New York office of the American Electrical Works, Providence, R. I., has secured for his company an order for 40 miles of wire, which is one of the largest contracts awarded to any wire company since January 1st.

The Standard Paint company of New York is sending to the trade an attractive little pocket-size catalogue and price list of the various P. & B. electrical compounds, and also containing several testimonials regarding the merit and satisfaction given by the goods handled by the company.

The Page Belting company, Concord, N. H., has lately completed and occupied several new buildings. The largest building is the belt shop, three stories high and 264 by 58

eet, and it is fully equipped with new and special machinery for the manufacture of belts.

The Nutting Electric Manufacturing company has secured new quarters for manufacturing at 128 and 130 South Clinton street, Chicago, and is rapidly recovering from its loss by fire. Preparations are being made for the extensive manufacture of the Nutting arc lamp.

The Iona Manufacturing company, Boston, makers of electrical supplies and specialties, of which N. Marshall is manager, has removed its factory to much larger and more commodious quarters at 336 Congress street. By this change its capacity will be more than doubled, and will enable it to take care of all orders hereafter with promptness.

The Ansonia Electric company, formerly the Electrical Supply company of Chicago, recently placed on the market a switch known as Wood's new adjustable switch. The success of this specialty justifies the claim of the company that it is one of the best switches known to the trade. It is made with adjustable tongues, which will allow it to be used as a right, left or diamond turn-out.

Taylor, Goodhue & Ames are getting their exhibit in electricity building at the World's Fair rapidly near completion and will shortly have an interesting exhibit to show to visiting electricians. Their alternating current motor will be especially worthy of careful attention, and will, no doubt, excite considerable interest among those who are interested in the development and utilization of the alternating current.

The Ball Engine company, Erie, Pa., continues to place its engines in a manner which cannot be other than satisfactory to the company. The New York office recently sold a 125 horse power engine to the Far Rockaway Electric Light company, Far Rockaway, Long Island. The Brockton Street Railway company, Brockton, Mass., has ordered a second 600 horse power cross compound engine of this company.

The Phœnix Iron Works company, Meadville, Pa., have sold the Saginaw, Mich., Power company two 300 horse power Dick & Church tandem compound engines. These engines will each be coupled directly to a 200 kilowatt generator. It has also sold the Wyandotte & Detroit River Railway company another compound engine of 150 horse power capacity. It has also closed a contract for eight horizontal tubular boilers for the street railway plant at Allentown, Pa.

The Pelton Water Wheel company reports an active business in its wheels and motors, both from San Francisco and New York branches. Among the recent installations made by this company may be mentioned the San Antonio light and power plant and the Redlands light and power plant, both in California. These plants are important on account of the distance the power is transmitted, being 28 miles in the first instance and 12 miles in the latter.

The business of the Nowotny Electric company, Cincinnati, O., has grown to such an extent that it has added another floor to its factory. It is now occupying three entire floors, and has put in a full line of modern machinery. It is especially prepared to do all kinds of electric repair work, such as winding armatures, re-building machines, making commutators, etc. In addition to this it carries a full line of electric light and street railway supplies.

The Electrical Appliance company of Chicago is pleased to announce that the new Whitney volt meters and ammeters for alternating current work are now ready for the market. The company claims to have overcome the difficulty heretofore experienced with the alternating instruments caused by varying frequencies, and to have produced an instrument that can be placed on any circuit without a special recalibration and give absolutely correct readings.

The Genesee Electric Light & Power company of Genesee, Idaho, is running in its new quarters just completed, 1 new 100 horse power Buckeye engine, 2 Edison incandescent dynamos, 1 American Brush arc dynamo, with Oscar Erickson electrician, and Chas. Hough engineer. The officers of the company are: president, D B. Grant; vice-president, W. Harris; secretary, C. F. Burr; treasurer, L. K. Krum; manager, H. Sampson.

The Star Electric Lamp company, manufacturer of the new Sunbeam high-grade incandescent lamp, has made a very good impression on the trade by its energetic and successful work in bringing out so quickly a new lamp and being ready so soon for immediate delivery of goods. What the lamp purchaser wants is lamps, and the Star company is now not only ready to take orders, but it is prepared with a good stock from which to make prompt deliveries. Secretary A. S. Terry of the company reports that there is a gratifying and growing demand for the new lamp and that purchasers are showing their appreciation not by congratulations only, but by orders.

Clark & Marshall have now got settled in their new quarters, 345 Rookery, Chicago, where they are carrying a complete line of choice electrical specialties. They are now ready to take orders for their new model fan motors. The company's motive power is chiefly electricity, and it possesses an elaborate system of electric lighting in its buildings and on its grounds. A belt was completed by this company recently for exhibition at the World's Fair which is claimed to be the longest in the world. It is 102 inches in width and over 200 feet long. Two other large belts have been turned out, one 72 inches and the other 73 inches in width which are to drive Westinghouse dynamos for lighting the buildings at the fair.

Riehle Bros. Testing Machine company, Philadelphia, is installing an extensive exhibit at the World's Columbian Exposition, machinery building. The exhibit is in charge of J. R. Matlack, jr. At the government building in the government exhibit, in charge of Capt. A. H. Russell, will be found a Riehle 200,000 pound vertical screw power testing machine; and in the quartermaster's department in the government building a 200 pound cloth testing machine. These were loaned by the Riehle Bros. Testing Machine company to add to the government exhibit. An exhibit of the Riehle-Robie patented friction less ball bearing screw jacks will be found in the government exhibit, as well as in the space of Riehle Bros. Testing Machine company.

Taylor, Goodhue & Ames have just moved into their new store, 348 Dearborn street, Chicago, where, although they are not yet fully settled, their rapidly increasing business can be handled to the best satisfaction of customers. They report an unusually large demand for Wagner power motors, fan motors and their large line of transformers. This company, although but recently in the market for business, has experienced a very flattering demand for its goods and recognition among electrical buyers throughout the United States, Canada and Mexico. This company is making rapid advancement in development of electric heating and cooking devices under the Burton patents, and is now placing upon the market all styles and designs for electric cooking utensils. There have been many practical improvements in cooking devices, made under the Burton patents, and it is claimed that they may be operated with much greater economy than other designs.

ELECTRICAL PATENTS.

Issued May 2, 1893.

496,402. Musical Instrument. Richard Eisenmann, Berlin, Germany.

496,409. Electric Arc Lamp. Frits Hansen, Leipsic-Reudnitz, Germany.

496,427. Electrically Operated Overhead Traveling Crane. William H. Morgan, Alliance, O.

496,428. Locomotive Crane. William H. Morgan, Alliance, O.

496,429. Gravity Brake for Vehicles. William H. Morgan, Alliance, O.

496,430. Locomotive Jib Crane. William H. Morgan, Alliance, O.

496,432. Magnetic Crane. William H. Morgan, Alliance, O.

496,433. Pillar Crane. William H. Morgan, Alliance, O.

496,449 Perforated Pole Piece for Dynamo electric Machines. Charles E. Scribner and Ernest P. Warner, Chicago, Ill.

The dynamo is provided with consequent pole pieces, which are perforated across their centers or bored out eccentrically in such manner as to produce a field having the lines of force uniform as to strength and direction with respect to the coils of the armature. This construction enables the driving of the armature indiscriminately in either direction and the shifting of the brushes upon the commutator to vary the electromotive force of the machine to maintain the current strength uniform under a varying load. When consequent pole pieces have their faces concentric with the armature and without perforations at the center, the lines of force are unevenly distributed, and on account of this uneven distribution of the lines of force, with relation to the armature coils, it has been impracticable to run the armature in either direction.

496,455. Electric Lighting System. Elihu Thomson and Edwin W. Rice, jr., Lynn, Mass.

496,456. Commutator for Dynamo-electric Machines. Elihu Thomson, Swampscott, Mass.

496,474. Electric Bunch Light. Joseph Dillon, Larchmoot, N. Y.

496,500. Electrical Measuring Instrument. Edward Weston, Newark, N. J.

496,501. Shunt for Electrical Measuring Instruments. Edward Weston, Newark, N. J.

496,513. Vibratory Telegraphy. Stephen D. Field, Yonkers, N. Y.

Each station is connected by line wires with the secondary of a transformer located at the central office. The primaries of the transformers are connected together and with a thermal vibrator, which produces pulsations or undulations inappreciable to the ear. These inaudible pulsations supply the lines with current, so that when audible vibrations are produced upon the line by the transmitters the vibration is transmitted from the secondary of one transformer through the primaries to the secondary of the other.

496,514. Armature for Dynamo-electric Machines. Waldemar Fritsche, Berlin, Germany.

496,517. Manufacture of Electrodes for Primary or Secondary Batteries. Rudolph T. E. Hensel, Dresden, Germany.

The electrode is composed of a metallic salt or oxide having an electrolytic action and a medium or cement, comprising an acid, gelatine and an alkali; the mixture thereby acquiring the consistency of a plastic mass.

496,519. Thermo-mechanical Alarm. Philip Krumscheid, Boston, Mass.

496,522. Controlling and Equalizing Electric Motors. David Mason, Schenectady, N. Y.

496,533. Electric Distribution System for Railways. Nelson W. Perry, Cincinnati, O.

The system comprises a supply conductor and a supplemental conductor, the latter being composed of relatively insulated sections. The sections are connected with the supply conductor by connections normally open, and are adapted to be closed by an electro-magnetic device included between the section and the return conductor when the trolley shall have made connection with that section.

496,549. Printing Telegraph Instrument. Alexander H. Wirsching, Brooklyn, N. Y.

496,550. Electric Locomotive. Eben M. Boynton, Wes Newbury, Mass.

496,551. Mail Pouch Deliverer. Ernest W. Bradford, Indianapolis, Ind.

496,567. Utilizing Electric Motors for Operating Machinery. Carl Hoffmann and Ernest Richter, Berlin, Germany.

496,591. Apparatus for Making Blanks by Electricity. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass.

The strip of metal from which the blanks are to be cut passes between electrodes of an electric circuit in passing to the dies, being thereby subjected to a heating action sufficient to raise the metal to the proper temperature.

496,592. Working Brass by Electricity. George D. Burton, Boston, Mass.

Heretofore considerable difficulty has been experienced in working brass, due to its brittleness and liability to crack. The patented method consists in passing a current of electricity through the bar to be operated upon, thereby raising the temperature of the core to approximate fluidity, while at the same time maintaining the temperature of the exterior so far below that of the interior as to preserve its form and homogeneous character.

496,593. Electric Forge. George D. Burton, Boston, Mass.

496,594. Electric Forge. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass.

496,597. Electro-platiog Apparatus. Seth C. Catlin, Bloomfield, N. J.

496,602. Electric Signaling Apparatus. Stephen D. Field, Yonkers, N. Y.

496,611. Automatic Safety Switch. Adelbert E. Hutchios, Detroit, Mich.

496,618. Electric Gas Lighter. David J. Quinn, Brookline, and Paul W. Hoffmann, Boston, Mass.

496,631. Double Pole Trolley. Thomas E. Adams, Cleveland, O.

496,648. Magnet Armature. Fred L. Gregory, Chicago, Ill.

496,652. Insulator for Telegraph Wires. Ralph G. Hemingray, Covington, Ky., and James C. Gill, Muncie, Ind.

The insulator is of the ordinary kind used on telegraph poles, but is provided with a series of cleats or conical projectors at its lower edge, whereby water on the insulator will flow off in drops.

496,658. Galvanic Battery. Frank K. Irving, Brooklyn, N. Y.

496,659. Hot Box Detector. Robert C. Kerr and Peter Hardman, Fall River, Mass.

In a small chamber provided in the journal box is placed a thermo-stat adjusted to close an electric circuit when the temperature in the chamber reaches a pre-determined amount due to the heating of the bearing. The circuit thus closed rings a bell or other signaling device.

496,678. Voltmeter. Arakelyan H. Armen, Lynn, Mass.

496,688. Fare Register. Stephen C. Houghton, San Francisco, Cal.

496,690. Electric Alarm. Henry F. Kolbe, Detroit, Mich.

496,701. Electrode for Arc Lamps. John F. Sanders and Sarah J. Sanders, Portland, Ore.

The electrodes are adapted for lamps of the arc light type, in which the carbons rest in contact continuously during the burning of the lamp. The carbons are composed of a homogeneous mass of carbon, a light giving metallic salt, a reducing agent and a binder.

496,702. Electric Arc Lamp. John F. Sanders and Sarah J. Sanders, Portland, Ore.

The lamp is adapted to maintain the electrodes continuously in contact during the burning of the lamp, each electrode being acted upon by a spring, thereby causing the electrodes to feed toward one another. The tension of the springs may be varied to change the pressure with which the electrodes make contact, thereby varying the brilliancy of the light.

496,710 Friction Coupling for Dynamos or Motors. Elihu Thomson, Swampscott, Mass.

496,713. Wire Stretcher and Holder. Adolf Westmeyer, Pacific, Mo.

496,724. Burglar and Fire Alarm. William C. Dillman, Brooklyn, and George A. Seib, New York, N. Y.

496,728. Electric Meter. Joseph Edmondson and Joseph Oulton, Bradford, Eng.

496,743. Element for Galvanic Batteries. Auguste L. de Meriteus, Paris, France.

496,746. Correcting Electricity Meters. Joseph Oulton and Joseph Edmondson, Bradford, Eng.

496,775. Electric Forge. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass.

496,786. Electric Signaling Apparatus and System. Jacob W. Lattig, Easton, Pa.

496,787. Electric Signal Apparatus. Jacob W. Lattig Easton, Pa.

496,791. Armature Attachment. William D. Packard, Warren, O.

496,792. Attaching Device for Electric Light Fixtures. George Peeples, Philadelphia, Pa.

496,801. Electrical Testing Outfit for Cables, etc. Edward W. Stevenson, New York, N. Y.

496,807. Electric Cut-out. Augustus Wright, Providence, R. I.

496,808. Electric Switch. Augustus Wright, Providence, R. I.

EUGENE F. PHILLIPS, Prest. W. A. HATHAWAY, Treas. W. H. SAWYER, Sec'y.

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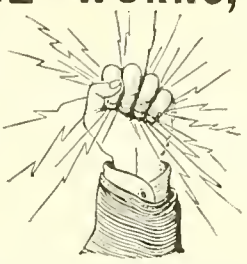

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Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

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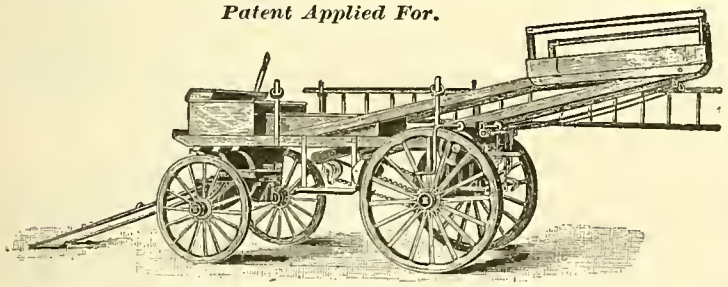

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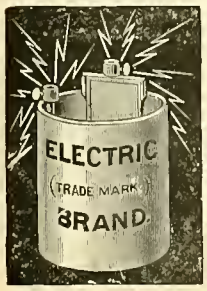
Beware of loose woven imitations.



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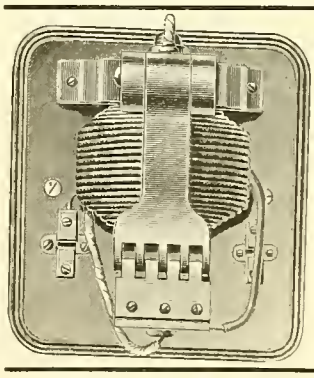

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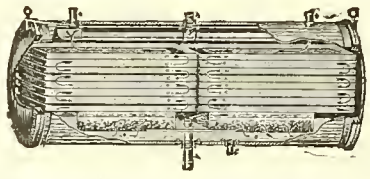

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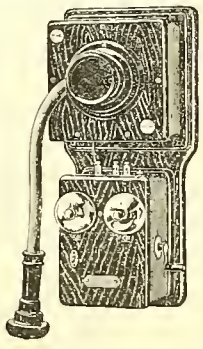

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Said railway property and franchises consist of about 6¼ miles of double track, being about 13 miles of single track, in said city of Milwaukee, with all the poles, wires, cables, trucks, ties, stringers, fixtures and appliances composing or used in connection with said tracks or said railway, with franchises, privileges and rights derived from ordinances of the common council of the city of Milwaukee to maintain and operate said road; also sundry parcels of real estate in said city, with car barns and power house thereon; also the engines, boilers, machinery and rolling stock and supplies of said road.

The terms of such sale are cash.

The said street railway will be sold free of all liens and encumbrances except judgments of foreclosure and sales aggregating $21,193.56, with interest from the 22d day of November, 1892, at 7 per cent. on $1,259.60 thereof, and at 6 per cent. per annum on the remainder. Said judgments of foreclosure covering the said specific parcels of real estate.

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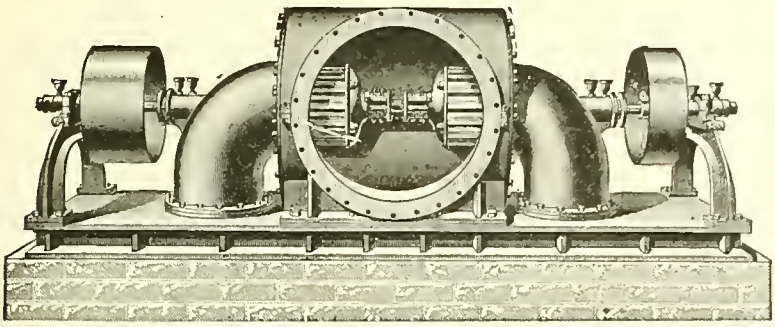

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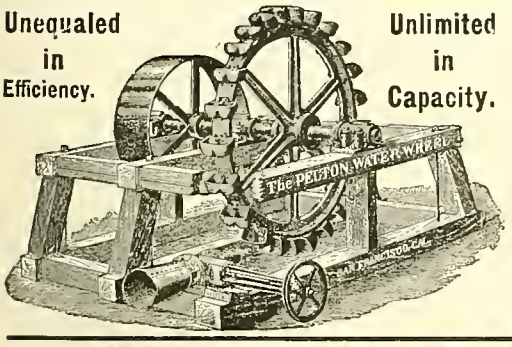

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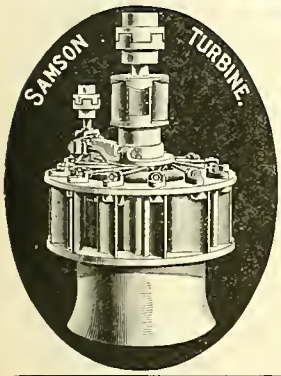

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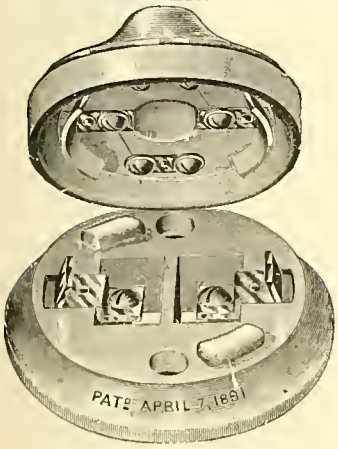

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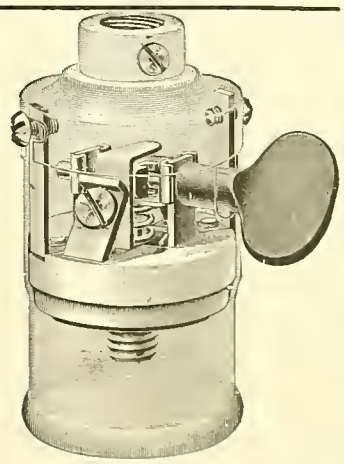

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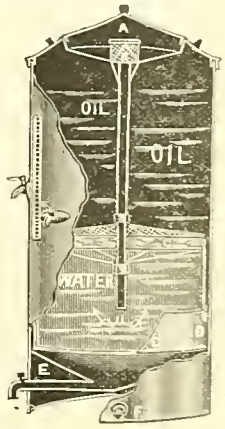

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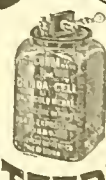

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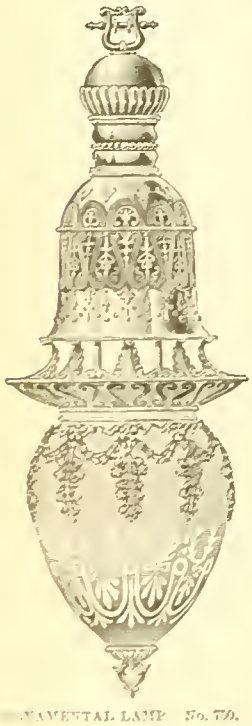

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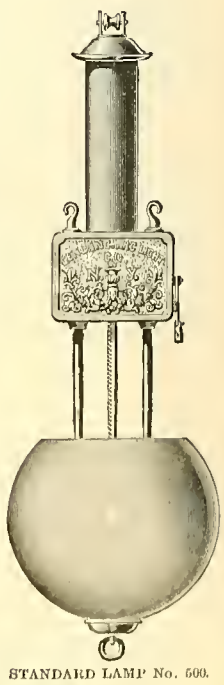

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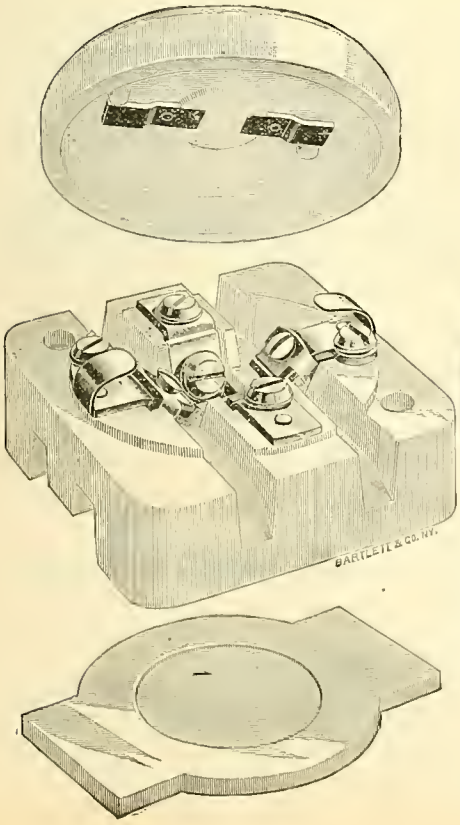

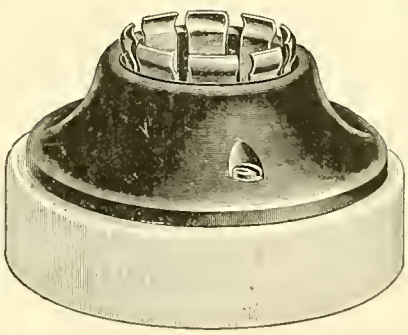

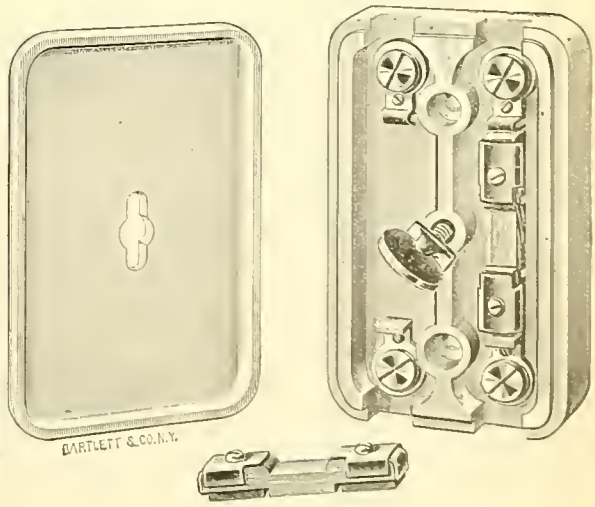

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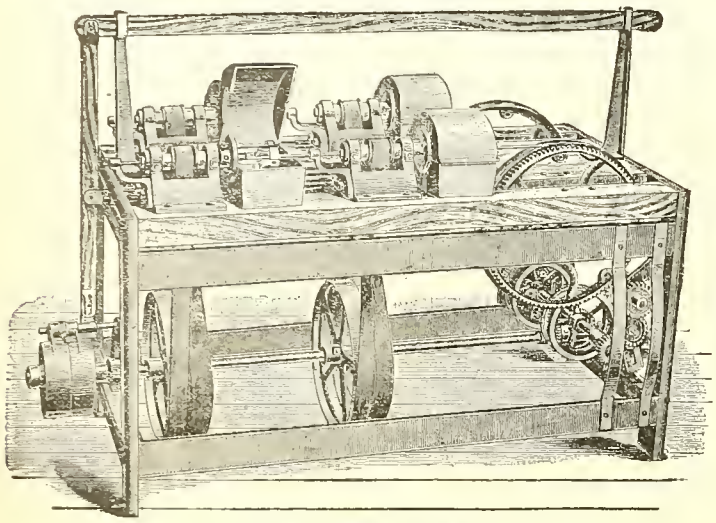

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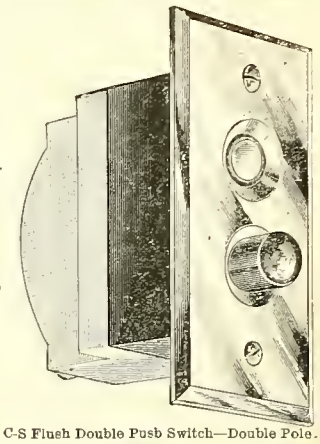

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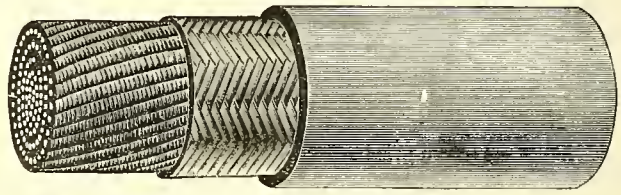

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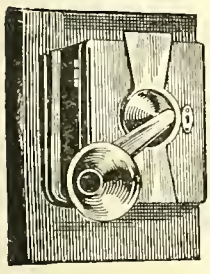
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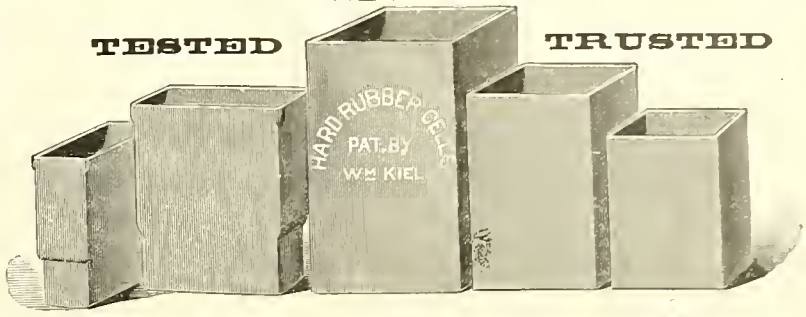

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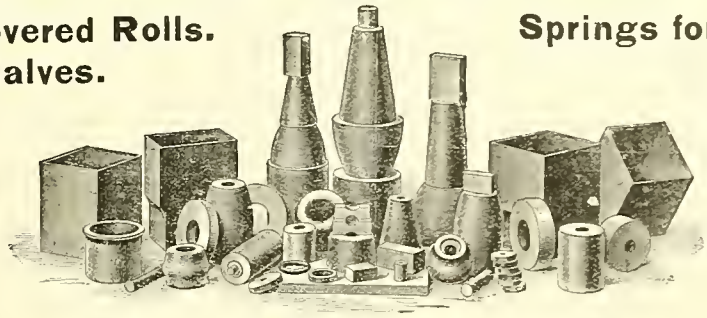
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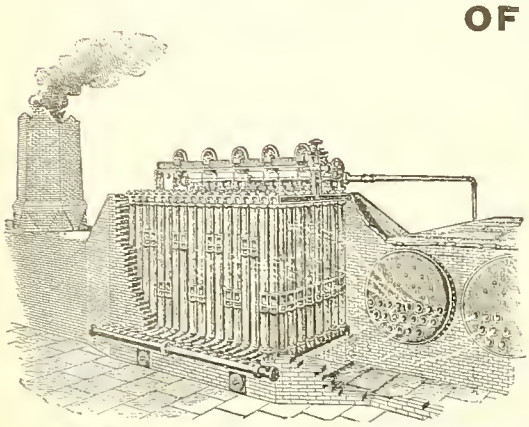

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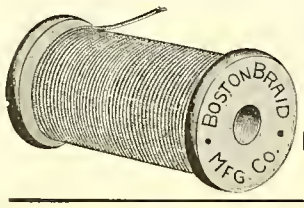

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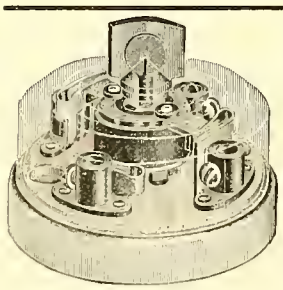

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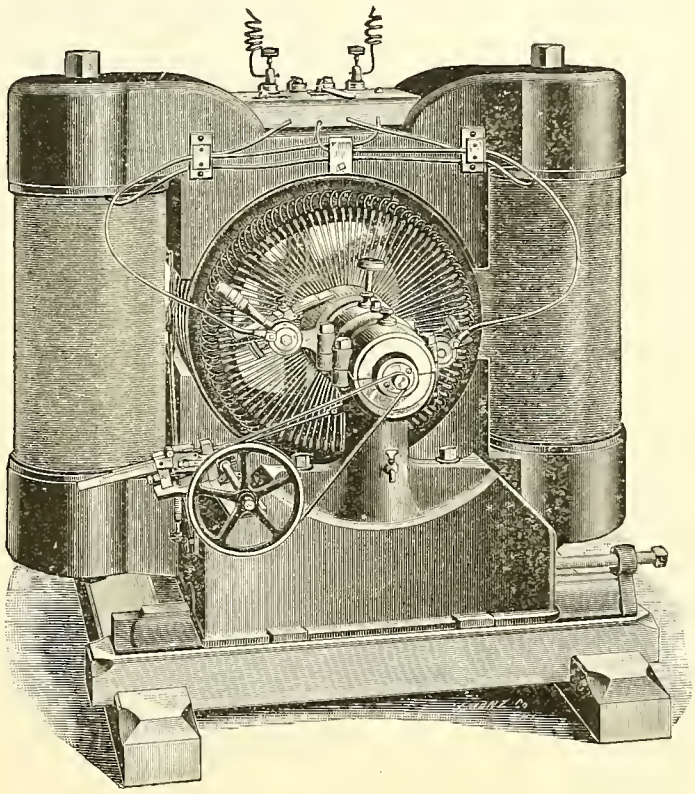

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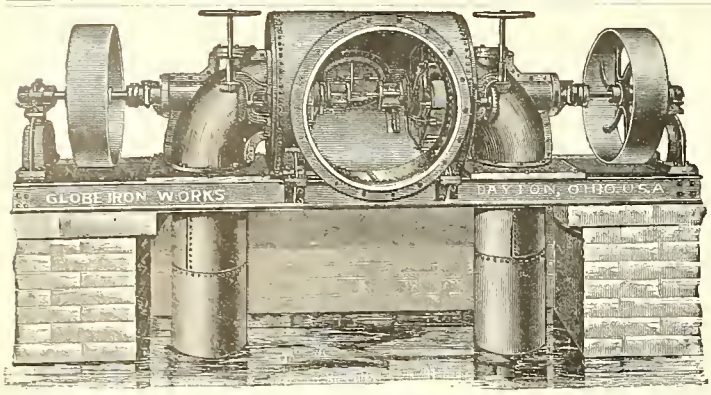

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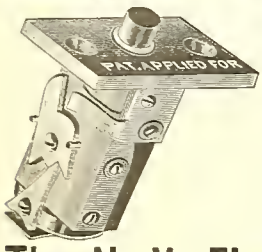

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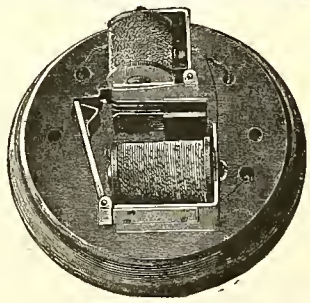

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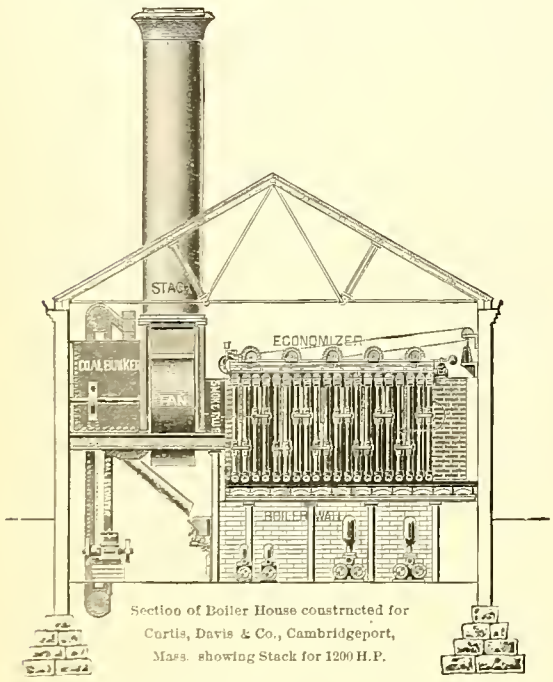

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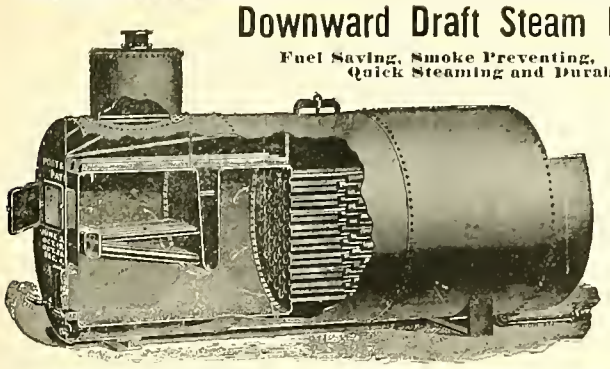

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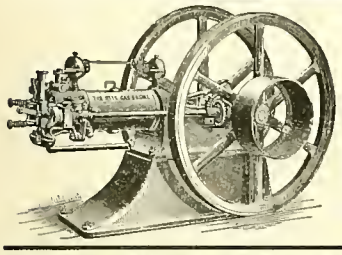

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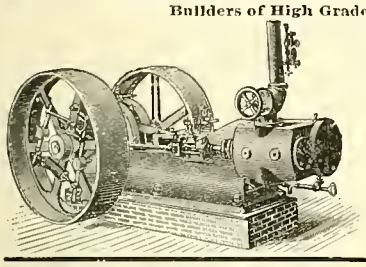

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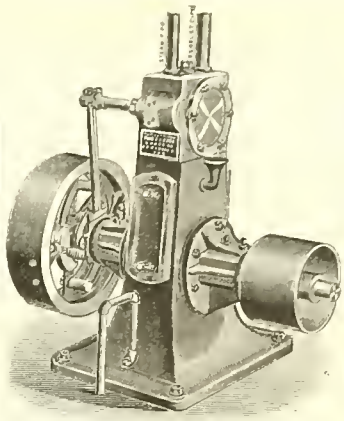

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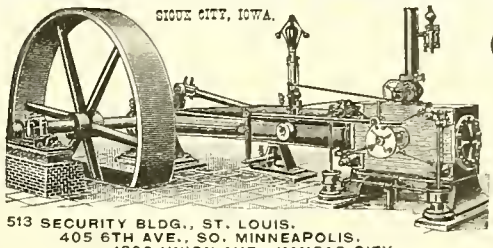

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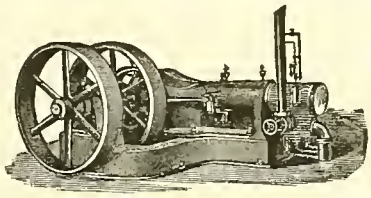

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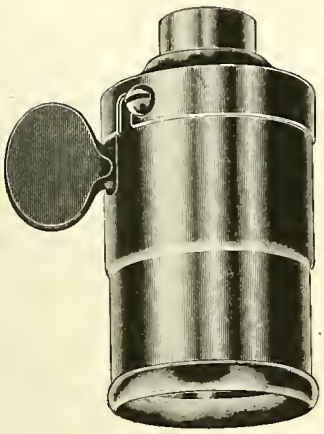
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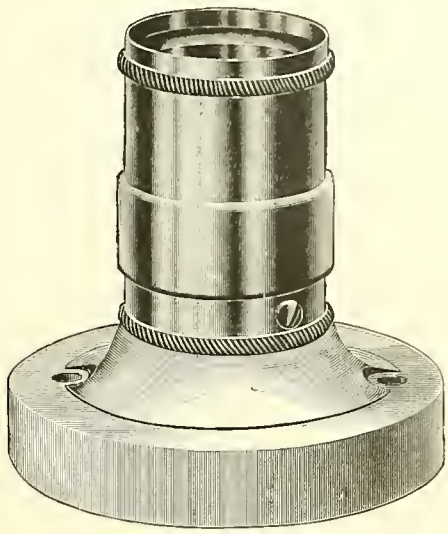
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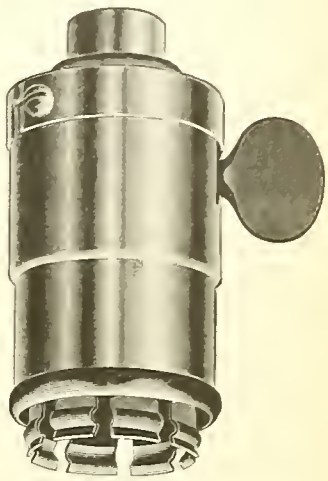
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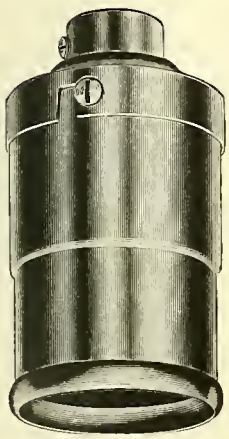
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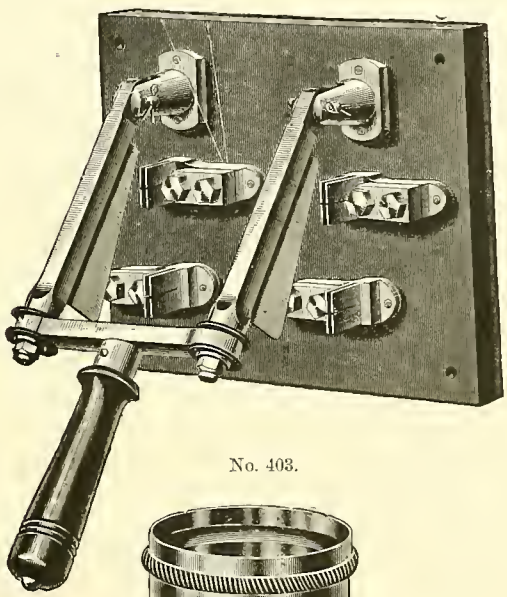
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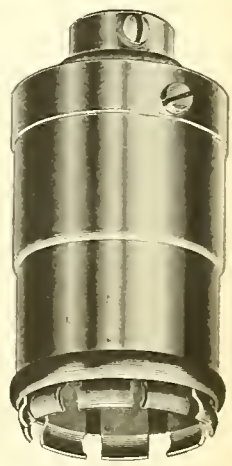
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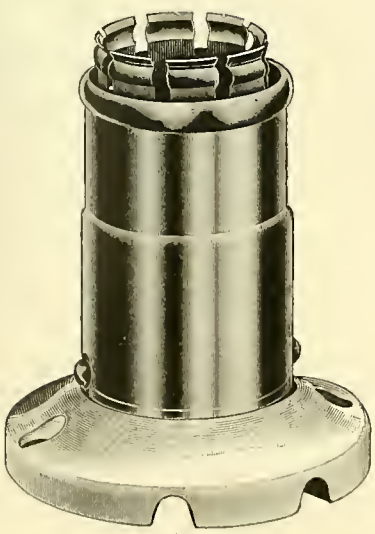
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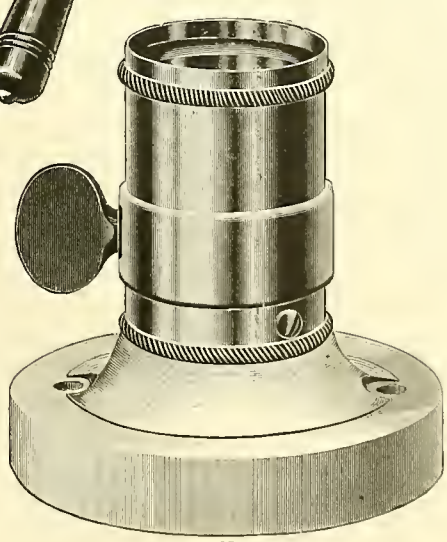
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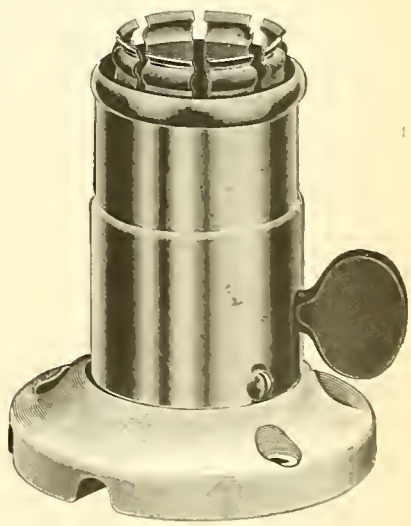
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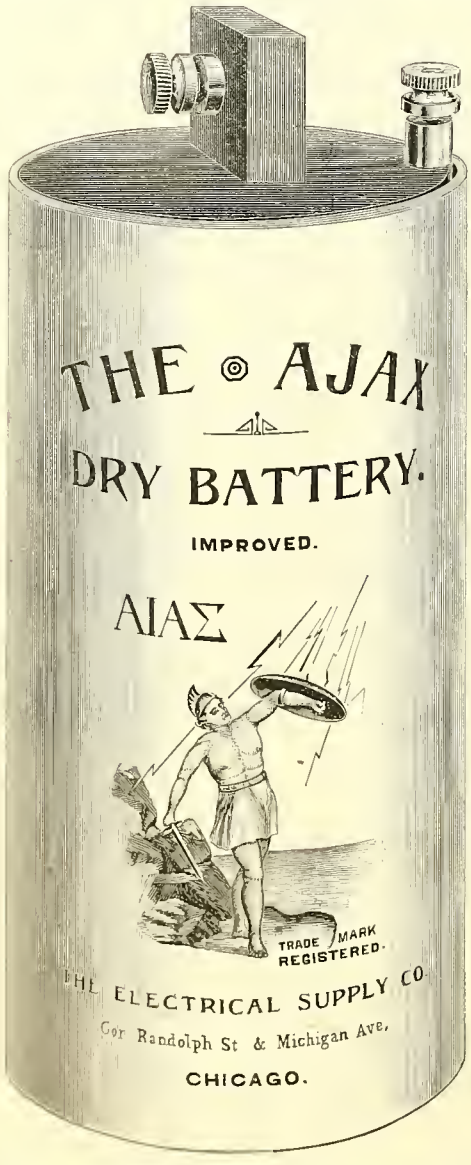

The above Battery was 30 inches high by 12 inches in diameter, and was manufactured expressly for this purpose. Its E. M. F. was about 6 volts with a current of 7 amperes. It is now on exhibition in the pavilion of The Ansonia Electric Co., north end of gallery, Electricity Building, Jackson Park.

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The filament used in the "Novak" lamp is the celebrated "Perkins" filament the superior quality of which is too well known to need comment by us.

We respectfully solicit correspondence in regard to the "Novak" lamp, feeling sure that a lamp possessing the superior qualities of this lamp, and manufactured by a company whose business it is to supply the general public without discrimination, will be appreciated.

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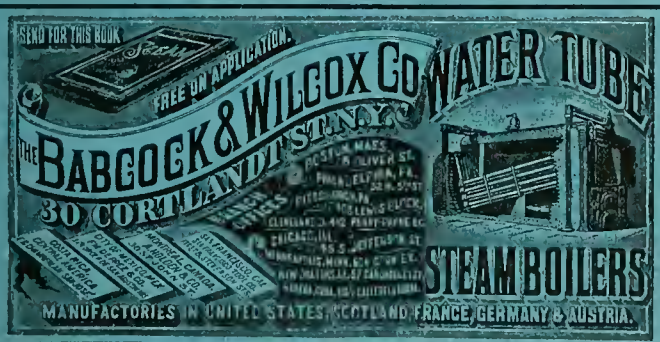

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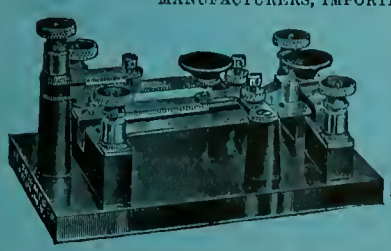

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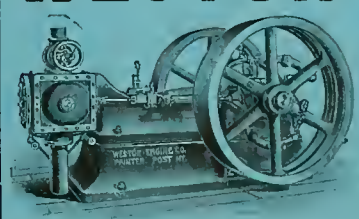

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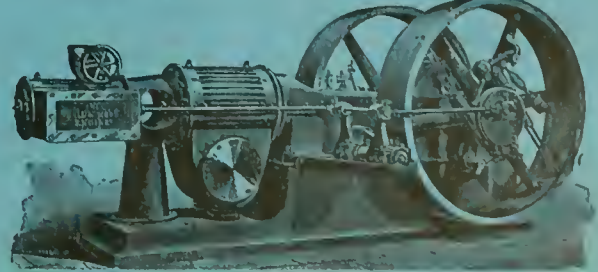

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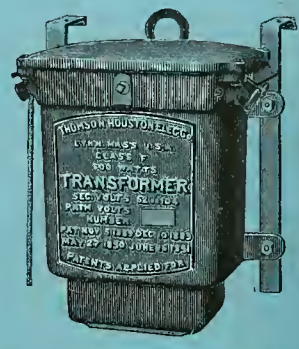

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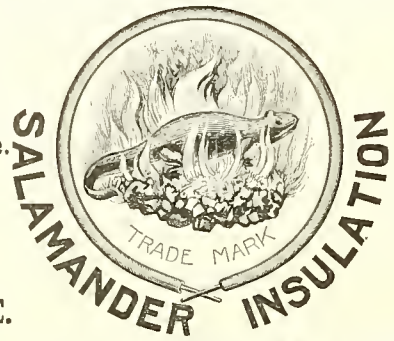

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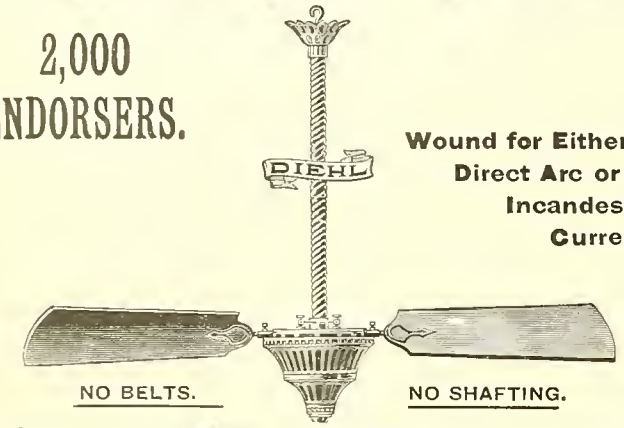

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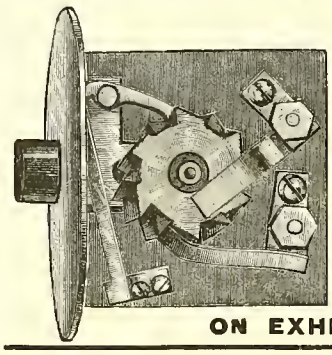

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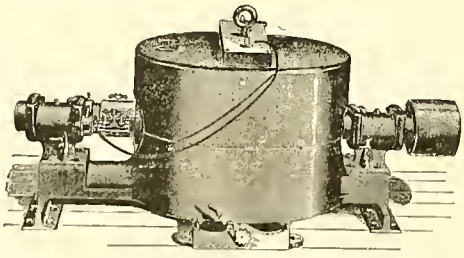

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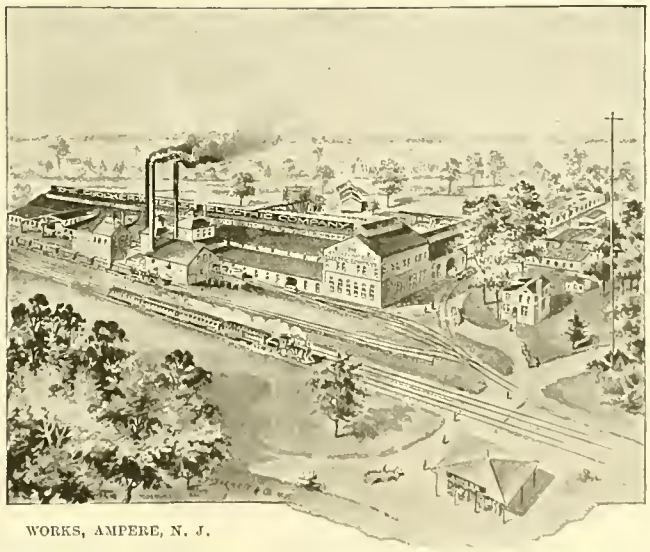

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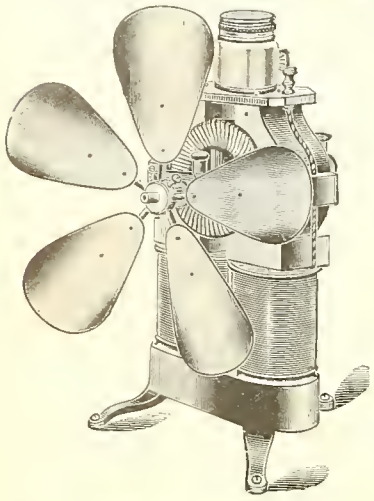

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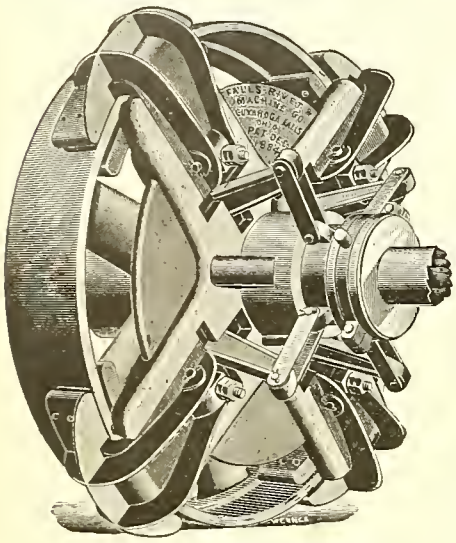

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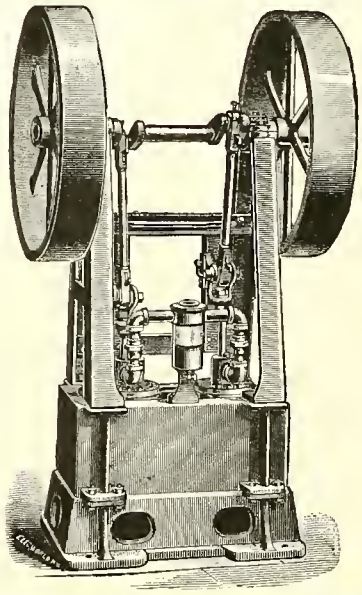

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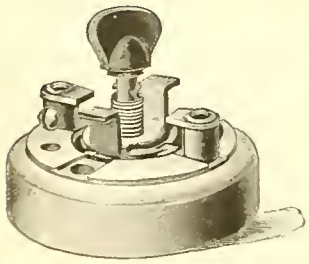

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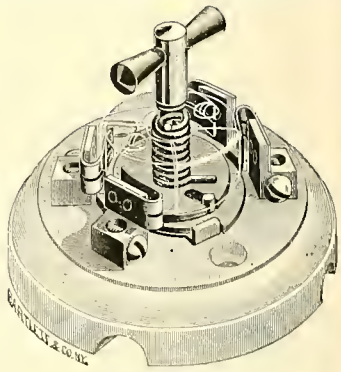

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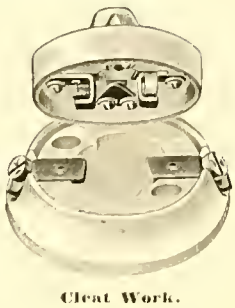

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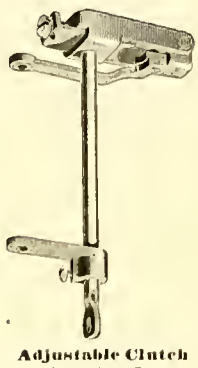

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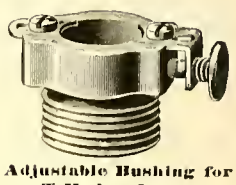

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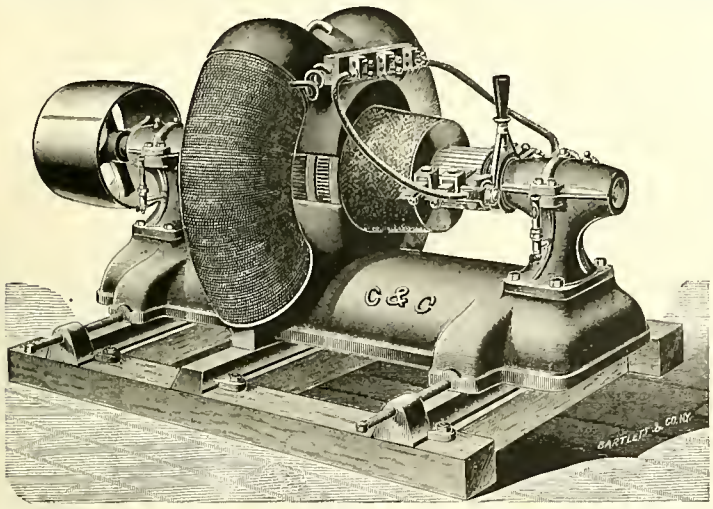

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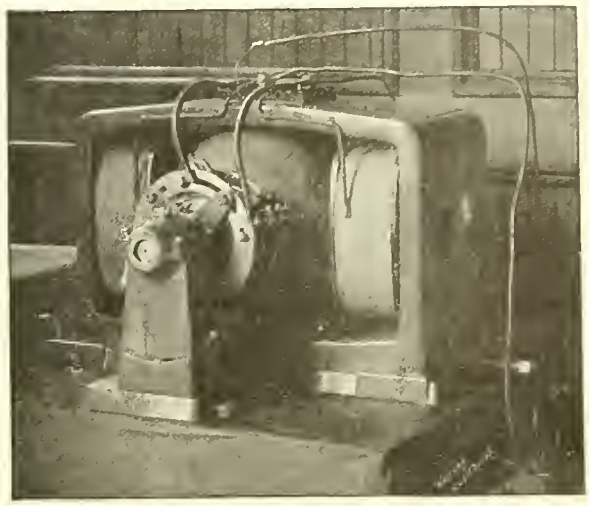

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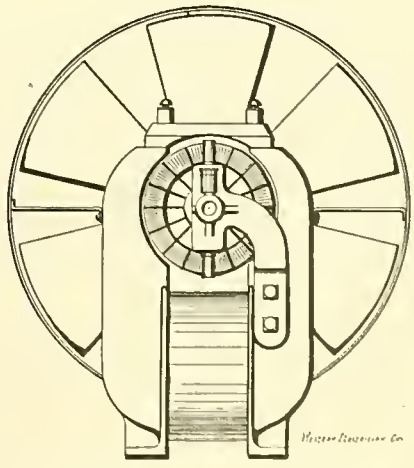

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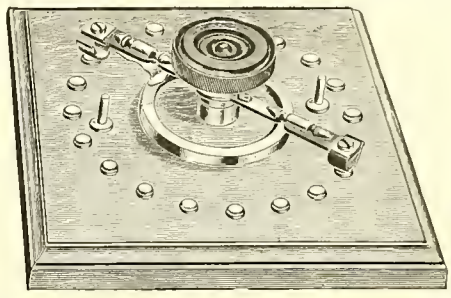

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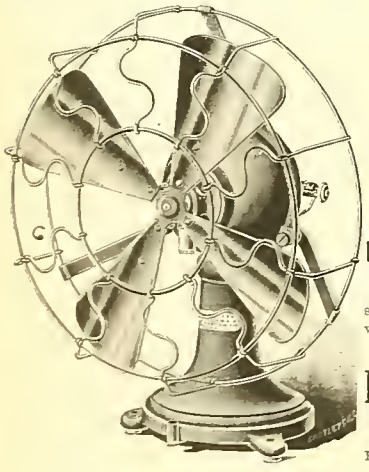

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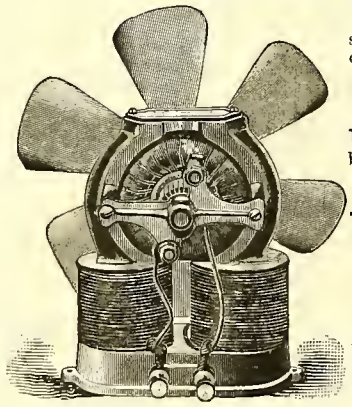

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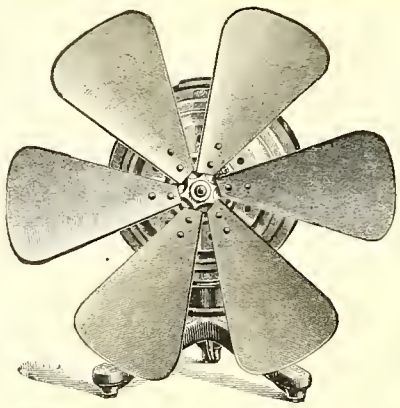

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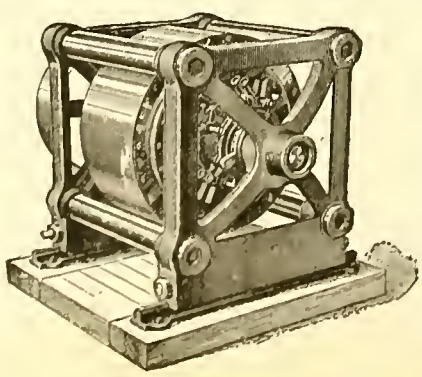

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Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, MAY 20, 1893. No. 20

Electricity at the World's Fair.

A row of boilers over 600 feet long, with a combined capacity of about 20,000 horse power, is a sight not often met with, and it is doubtful if a counterpart of the steam producing plant of the World's Fair, a perspective view of which is given on this page, is in existence. Certainly there is no plant of equal size in which oil is burned exclusively for fuel, and this fact alone makes the boiler house of the exposition one of the greatest attractions on the grounds to the mechanical engineer. The system of piping employed and the oil burners, which have heretofore been described in this journal, are also of exceptional interest. The use of oil enables the attendants to keep the plant in an ideal state of neatness, although up to the present time the space in front of the boilers has been considerably littered by material necessary for construction operations. The plant is especially designed with the view of being accessible to visitors. The floor is nine feet lower than that of machinery hall, of which the boiler house is an adjunct, and a gallery for spectators, twenty feet wide, extends the whole length of the room, 627 feet, on the same level as the floor of the main building. This gallery is supported by brick walls rising above the boiler room floor, and the half nearest the wall of machinery hall contains the feed water heaters, while underneath the heaters, on the ground floor, are placed the feed pumps that supply the boilers from the feed water heaters, through an overhead system of piping. The steam passes from the boilers at a pressure of 125 pounds through overhead pipes into a main header 800 feet long and 36 inches in diameter, the sections of which are connected by 10 inch steam equalizing loops arranged to take up the expansion. From the top of this main header the steam passes through pipes laid beneath the aisles of machinery hall to the engines in the respective blocks. The boilers comprising the plant are exhibits as well as a portion of the power installation, and they were furnished to the Exposition company without charge. All are of the water tube type, and the manufacturers represented are Abendroth & Root, Gill, Heine, the National company, Campbell & Zell, Babcock & Wilcox and the Stirling company. Practically the plant is a portion of the great electrical central station at the fair, as of the 20,000 horse power capacity 17,000 is for engines that drive dynamos. Central station men will therefore find it of advantage to make a thorough inspection of the boiler house. The electrical signaling and controling mechanism for the oil fuel plant is also of interest.

Especial efforts were made last week to complete the arc lighting of the pier, in view of Saturday evening's illumination. All the patrol lights about the grounds are now burning every night except those intended for the extreme southern portion of the park, which will not be needed for some time to come. All the corona lamps in the manufacturers building are now ready, and all the other buildings are wired for arc lights except the anthropological building. Arc lamps have furnished light in all the main buildings except transportation and horticulture.

The backward condition of the exhibits in electricity building is a disappointment even to the most optimistic friends of the department, who are disposed to make every excuse for shortcomings. Until April 1st, as noted in the

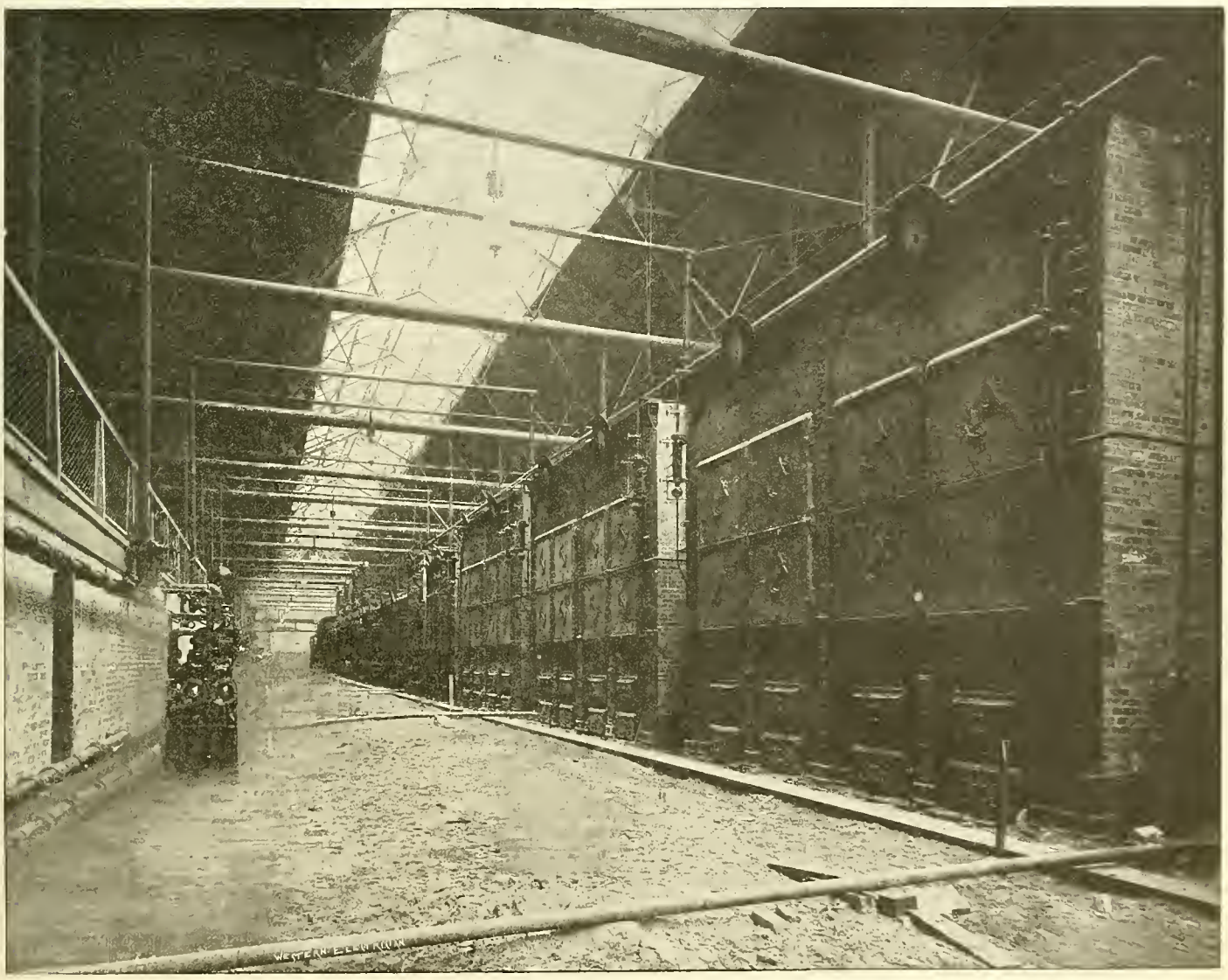


FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.—BOILER PLANT, MACHINERY HALL.

WESTERN ELECTRICIAN at the time, the prospect of a prompt completion of the display in electricity building was most cheering. The building was early cleared up; little complaint was made of roof leaks, which have caused so much trouble in other buildings, and everybody seemed eager and enthusiastic. But since then the work of installating exhibits has dragged, and the uncompleted appearance of the main floor and galleries has changed for the better with painful slowness. Finally Chief Barrett's patience became exhausted, and on May 9th he issued the following special notice to exhibitors:

Exhibitors in this department are unnecessarily behind in the completion of their exhibits, The department has taken every possible precaution to aid them, and wherever

possible has taken upon itself unusual responsibilities and labor to this end. The department has provided all-night lighting in the building, hoping that exhibitors would take advantage of the fact to work overtime and with double shifts of men. This has not been done, and the department declines to suffer further criticism from the management of the exposition and from the public on account of the dereliction on the part of the exhibitors. The director-general has fixed May 13th as the date by which all installation work must cease. It is therefore determined by this department to fix May 14th as the extreme limit of time for receiving and completing the installation of exhibits. All exhibits not absolutely complete on that date will remain during the period of the exposition in an unfinished state.

The effect of this order was immediately noticeable in the increased activity shown by exhibitors, but at the close of last week a survey of the building showed that it would be impracticable to enforce the literal provisions of the notice without entailing disgrace on the entire electrical fraternity. A tacit understanding was therefore arrived at by which the time was extended one week. The present indications are that the electrical display, as a whole, will be complete and ready for inspection on May 22d. As for the responsibility for the present conditions of affairs there are, of course, differing opinions. The exhibitors, with some notable exceptions, come in for severe criticism for the delay, but they, in turn, assert that the authorities of the exposition were largely at fault in not furnishing proper transportation facilities by which goods on arriving at the grounds could be taken to the place assigned. This applies to teaming trucks as well as freight cars, and it is said that the supply of broad-tired wagons, the only type allowed on the grounds, save in exceptional instances, was entirely inadequate. This was the fault of the construction department, however, and could not be ascribed to the department of electricity. There were also many changes at the last moment, not a little indecision and much waiting to see what the other fellow would do—in short the course of action often summed up under the comprehensive term, "monkeying." But this stage is now passed, apparently, and all are hard at work. It is hoped that a week will see the electricity building in the pre-eminent place it is entitled to as an attraction.

Just west of the "tower of light," on the ground floor of the electricity building, the General Electric company is installing an interesting scheme of power transmission. A 100 horse power, 500 volt, Thomson-Houston, continuous current motor is directly connected to a large Blake triplex pump with a capacity of raising 450 gallons of water a minute to a height of 650 feet. This electrically operated pump will take water from a 1,500 gallon tank and force it through an overhead pipe to a Pelton water wheel, from which the water will fall into a second tank and flow back into the first by gravity, thus being used continuously. The Pelton wheel will drive a three-phase generator, to which it is directly coupled. This generator in turn will supply current for operating a number of multiphase motors, one of which will drive a hoist. A portion of the current will also be utilized for incandescent lighting. All the operations of this unique electrical and water power combination will be performed in full view of the spectators, who will thus be given a new revelation of the multiform applications of electricity. The big pump is a handsome piece of work and is powerful enough, if its full capacity were utilized, to send a stream of water through the roof of the building 100 feet above it. The installation work is in charge of R. Hofstede-Crull, a Dutch electrical engineer, who had charge of the Thomson-Houston International company's exhibit at the Frankfort exhibition.

In the line of exhibits that are "the biggest in the world" Germany may be credited with two—the 120 ton Krupp gun and the five-foot Schuckert search-light. The latter, which is of more immediate interest to the electrical fraternity, is now mounted on the northwestern corner of the promenade about the roof of the manufactures building, which is reached by four elevators in the northern part of the building. There seems to be no doubt that this is the largest projector yet constructed, and Mr. Tischendoerfer, the World's Fair representative of Schuckert & Co., challenges comparison with any search-light in the world operated under like conditions. The lamp itself is five feet in diameter, and it is claimed that the illuminating strength of the arc is 57,000 candle power, which is increased to 194,000,000 candle power on the surface of the parabolic mirror. This mirror is seven-eighths of an inch thick, and six months was consumed in the labor of grinding and polishing it. After the mirror was completed, great care was necessary, of course, in packing it for shipment to Chicago. A padded receptacle was made, and this was enclosed in a strong wooden framework. The mirror was attached in this cage by four chains at the corners, and jarring was prevented by lateral springs fastened to the sides of the framework. In this manner the fragile mirror was safely transported by land and sea to its final resting place on the manufactures building at Jackson Park. The illustration, Fig 2, represents the parts of the projector, as they stood on the floor of electricity building before the final location was decided. The mirror is shown in its temporary frame in the center, and an idea of its size may be gained by comparison with the figure of the workman standing beside it. The drum of the lamp is on the left and the standard on which it is hung on the right. The operation of the lamp is similar to that of the four-foot projector shown on the transportation building at the World's Fair dedication last October, and described in the WESTERN ELECTRICIAN at that time. It takes 150 amperes of current with a potential difference of 60 volts at the lamp terminals, or about 12 electrical horse power. The positive carbon is 1½ inches in diameter and the negative carbon 1 inch.

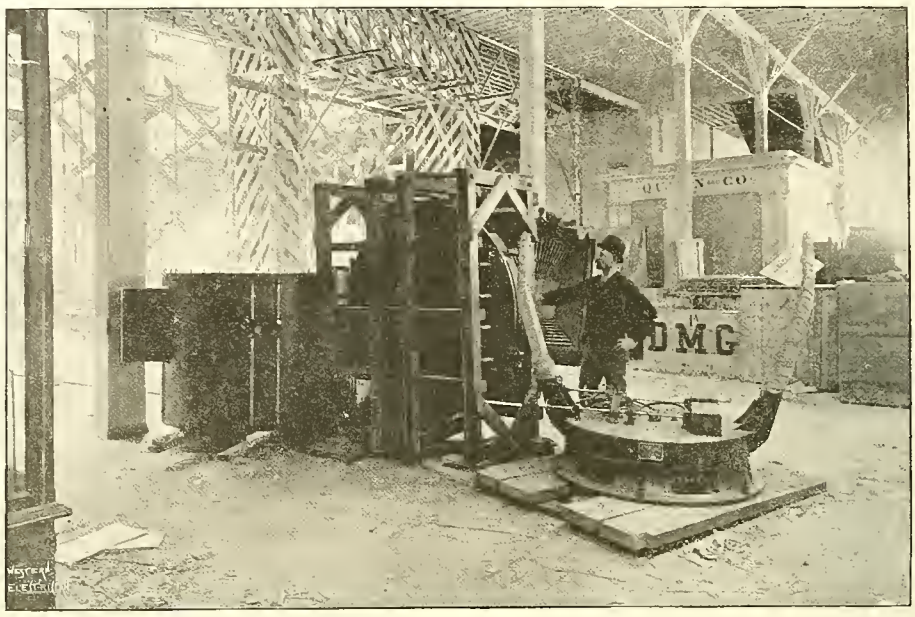


FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.—THE LARGEST SEARCH LIGHT IN THE WORLD ON THE FLOOR OF ELECTRICITY BUILDING, READY FOR MOUNTING.

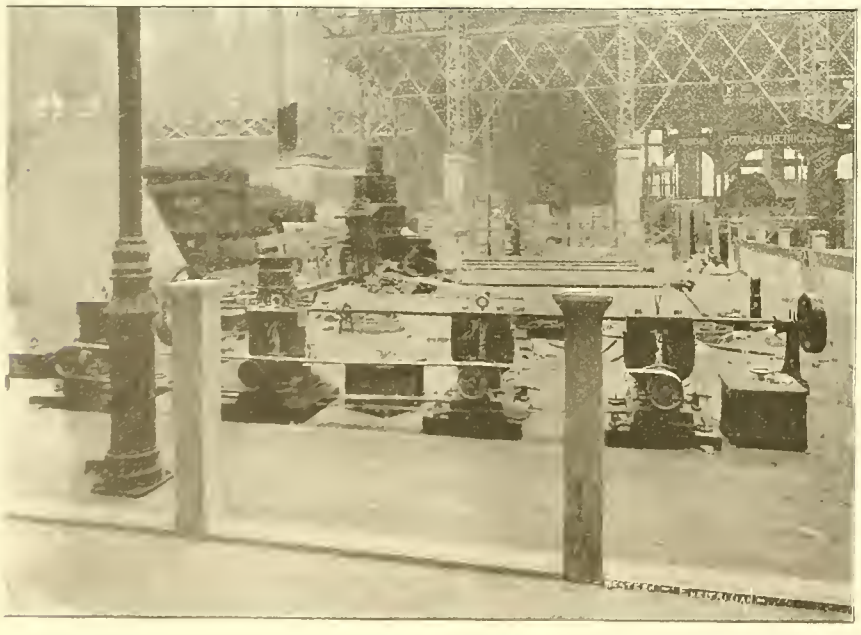


FIG. 3. ELECTRICITY AT THE WORLD'S FAIR.—INGENIOUS ARRANGEMENT OF MOTORS AND DYNAMOS FOR TELEGRAPHIC PURPOSES.

An interesting "wrinkle" is that illustrated in Fig. 3, which shows the method adopted for supplying current for the Western Union quadruplex system. The principal office of the telegraph company is in the administration building, but as Mr. Edison invented the quadruplex instrument the current generating apparatus is shown in the space devoted to his personal exhibit in electricity building. Here only 500 volt circuits were available for power, and two 250 volt Edison dynamos were connected in series with this circuit and operated as motors, belted together so that they would run in synchronism. To these motors two other 250 volt machines were belted in tandem and run as generators. The fields of these dynamos were weakened by rheostats sufficiently to produce a current of a pressure of 300 volts, which was distributed to the Western Union circuits on the three-wire system. This ingenious arrangement produced the curious disposition of belts shown in the picture. It was a temporary expedient, pending the arrival of a larger motor and the erection of a line of shafting, but it answered the purpose satisfactorily.

The Electric Launch & Navigation company now has twenty electric boats in operation on the lagoons of the World's Fair, and they are enjoying a good patronage. There is also another boat in service for the use of exposition officials. Nearly one hundred men are now employed by the company under the direction of Gen. C. H. Barney, the superintendent. Fifty boats will be running at the height of the season, and the prospect for a great rush of business is excellent, as no electrical feature of the fair has given more general satisfaction than the launch service. Each boat has a pilot and guard, and turnstiles and ticket boxes are being erected at the landings, so that each passenger will pay his fare before getting on the boat. Each boat is provided with a whistle operated by compressed air. The regular speed is six miles an hour, but the special boats provided for officers of the exposition can be run at the rate of 10½ miles an hour. All the boats are graceful in appearance, but the special launches are particularly handsome. Thus the director-general's is planked with mahogany instead of cedar, and has an

orange-colored awning instead of the familiar stripes. Chief Burnham's launch has a white awning and the two boats of the council of administration have striped awnings, but with the colors reversed, as compared with the ordinary boats. The boats are not named but numbered.

After some delays in installation the three electric traveling cranes in machinery hall were placed in operation and have proved of great assistance in placing the heavy machinery. Photographs of two of them—the Yale & Towne and Morgan—are reproduced in Figs. 4 and 5. The former picture also gives an excellent idea of the manner in which the machinery is massed in the building. United States motors are used on the former crane and Thomson-Houston on the latter. The third crane was furnished by William Sellers of Philadelphia and was the last to be put in position. It is the intention to fit up the cranes for the transportation of passengers after all the exhibits have been installed.

FIG. 5. ELECTRICITY AT THE WORLD'S FAIR —ELECTRIC TRAVELING CRANE, MACHINERY HALL.

On two evenings last week—Monday and Saturday—the park was open to visitors, and the electrical illumination of the grounds and buildings was made the feature of both occasions. On Saturday evening the arc and incandescent lighting was the most elaborate yet attempted, and a large throng of spectators, estimated at 50,000, was drawn out to witness it. The scene about the central "court of honor," where the greater part of the visitors congregated, was very beautiful and impressive. The administration building, completely outlined by rows of incandescent lamps, with the interior brilliantly illuminated, was the central feature, and it excited unbounded admiration. The manufactures, electricity, mines, agriculture and machinery buildings were all brightly lighted by arc lamps and were open to the public. The horticultural and fisheries buildings were partially lighted, while hundreds of arc lamps about the grounds added to the general effect. The brilliance of the central court was greatly increased by the thousands of incandescent lamps placed about the basin and on the bridges, just above the water, the reflection in the latter element adding much to the effect. The electric fountains were in operation but were not electrically illuminated. A search-light on the southwestern corner of the manufactures building threw a white beam of light in various directions, but most frequently on the dome of the administration building. The cornice line of the peristyle and music hall was also prettily lighted by incandescent lamps. In all, about 10,000 incandescent lamps were burning on the grounds, about 8,000 of these being carried on one of the big Westinghouse alternators belted to the Allis engine, and the remainder on a 4,000 light alternator. About 1,000 arc lamps were burning. The lighting of the northern part of the grounds was insufficient, but the visitors, enlivened by the music of three bands, seemed, on the whole, to be well pleased.

The first of the large electric manufacturing companies to complete its exhibit in electricity building is the Western Electric company of Chicago, which was one of the first to begin work. This company has an exceedingly attractive display, which is divided into two portions, one of which is located in machinery hall and the other in electricity building. The former consists of twelve 50 light arc machines and two 200 horse power 220 volt generators. Ten of the arc machines are used in lighting the grounds and a portion of the buildings. The other two arc machines are used in lighting the exhibit in electricity building. The arc machines are of the latest type, an especial feature of which is the carbon brushes, which require no lubrication on the commutator. They are to be operated by Watertown, Erie and New York Safety engines.

The generators are used for transmitting current for lighting the exhibit in electricity building. They are of the multipolar type, and the armatures are Gramme wound. The brush holders of these machines are so constructed as to render the running of the machines almost noiseless, and the method used for tightening and slackening the belts is worthy of attention. The dynamo rests upon rollers which revolve on an iron sub-base, thus reducing to a minimum the friction when the machine is being moved backward and forward. These machines are driven by belts supplied by the Graton & Knight Manufacturing company, Worcester, Mass., power being furnished by two 200 horse power and one 100 horse power Russell engines manufactured by Russell & Co., Massillon, O.

The switchboard in this space combines both the arc and incandescent circuits, and is made of brown Tennessee polished marble, the back being as elegant in its fittings as the front side of the board. In connection with the arc system the board is equipped with a system of ground alarm which notifies the attendant by the dropping of a shutter whenever a ground is made on any of the circuits. Provision is also made by which the insulation with respect to ground of arc circuits can be measured at any time while the machines are doing duty. All of the wiring from machinery hall to electricity building is carried through the subway, the wire being fastened to the glass insulators by means of specially made clips, no tie wire being used. This clip is intended to prevent an abrasion of the insulation. In the electricity building the circuits run into a switchboard of brown Tennessee marble equally as attractive as that in machinery hall. This board is also polished on both sides, and an examination of the back of the board will show the care with which the problem of distribution of the circuits has been wrought out.

Undoubtedly the most interesting features of the exhibit in electricity building in the way of decorative lighting consist of an Egyptian temple, a column of light with streamers representing lightning and large revolving balls of light fixed at the ends of the streamers, and an electric theater in which the scenic effects produced by electric lights will be shown. All are in the southeastern corner of the building, on the main floor.

The Egyptian temple is designed to represent the old Egyptian architecture, and is decorated upon the outside by Egyptian figures, representing the performance of the operations seen in the Western Electric factories, the workmen, in old Egyptian costume, being shown at work on the appliances which are displayed in the showcases placed in the interior of the temple. The interior of the building is a scene of beauty, and is divided into two rooms. Around the sides and corners of the rooms are placed glass pillars with Egyptian caps, all made of stained glass lighted from behind, while the ceiling in the small room is made of beautifully stained glass. Another novel feature of the illumination is the passageway of the small room, in which are placed over 400 16 candle power lamps. The light on these ceilings is constantly changing, which is done by means of an automatic revolving switch placed outside the building. Over the passageway of the temple are placed winged discs formed out of cut glass and illuminated behind by means of arc and incandescent lights. The total number of incandescent lamps used in the entire building is over 1,200. The decorative stained glass work was designed and executed by Healy & Millet of Chicago. For the comfort of visitors a 60 inch duplex fan under the floor keeps a current of fresh air circulating through the building.

Passing through the temple, the first thing to meet one's attention is the column of light, which consists of over 3 000 incandescent lamps wound spirally around the column and radiating upon streamers representing lightning, and ending in large balls, which are suspended thirty feet from the floor. The light apparently comes out of the floor, and, after rushing to the top of the column, flashes out on the lightning streamers and illumines the balls, which are revolving at a high rate of speed. These balls change color from red to white and then to blue, after which the light goes out and again appears at the base of the column. This effect is automatically produced by means of a large rotating switch concealed from view. The current used in this decoration is all 110 volt, whereas that used in the temple is 220 volt. The current is reduced from 220 to 110 by means of a motor generator consisting of two machines mounted on the same base and coupled shaft to shaft. This machine

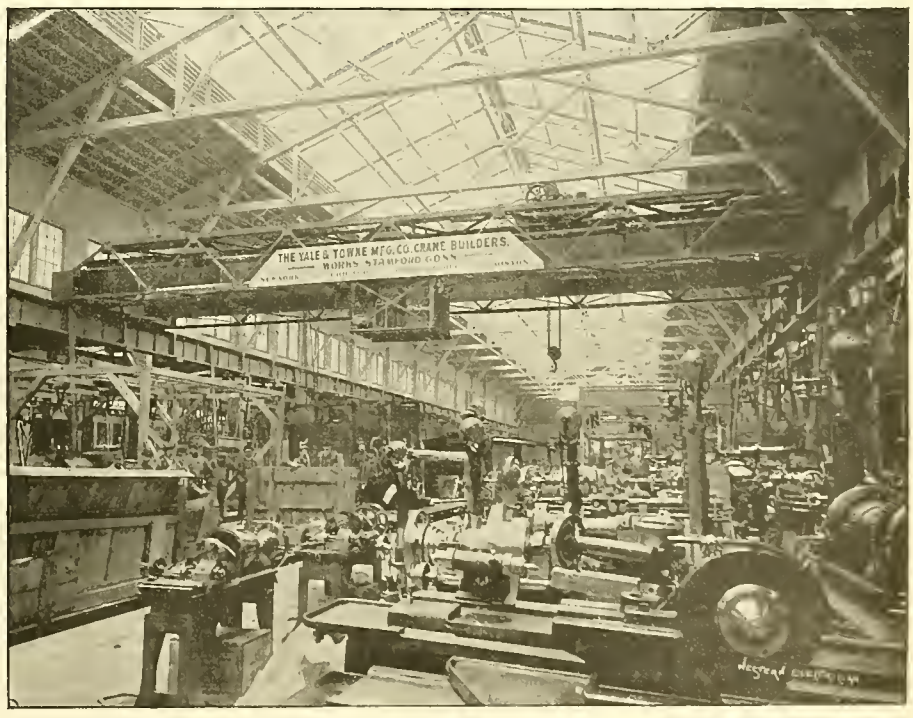


FIG. 4. ELECTRICITY AT THE WORLD'S FAIR.—ELECTRIC TRAVELING CRANE, MACHINERY HALL.

is located near the switchboard, and is of the slow speed type. Upon the switchboard is a device by means of which it is impossible to start the machine without first closing the rheostat on the armature circuit, thus preventing damage to the motor armature.

In the foreground of the model theater will be seen a beautiful electric fountain produced by incandescent lamps, while beyond is a mountain scene with streams of running water. The light effects in this scenery show to what extent the electrician's genius, combined with the artist's skill, can reproduce nature with all its beauty and realism. Near this theater is a writing machine, which spells out the letters "W. E. Co." A finger traces each letter, and while doing so, and at the same time, lights the lamps which produce the letters.

The exhibit also contains nearly every other form of appliance used in the field of electricity, and which is made at the factories of the Western Electric company. There are to be seen annunciators of all kinds, call bells, push keys, telegraph and telephone apparatus and telephone switchboards; also manholes, in which will be shown the system of underground cables made by this company, and all apparatus and appliances for putting these cables in position. Near one corner of the building is shown some of the dynamos and lamps manufactured by the Western Electric company.

One interesting department is devoted to historial displays, in which will be seen a street car engine and dynamo, which has been reproduced from descriptions given by the inventor, Moses G. Farmer. This machine is supposed to be the first reversible motor ever produced, and was made and operated in 1847. Some of the wheels and one of the seats in this exhibit are the ones used in the original. Near by are two incandescent lamps which were made by Mr. Farmer in 1859, and which are mounted upon an old mantelpiece, used by the inventor for holding the lamps in his old home in Salem, Mass. One of his early dynamos is also shown in this exhibit.

Another attractive feature is the working exhibit, in which are shown in operation some of the machines which have been invented by the Western Electric company, and

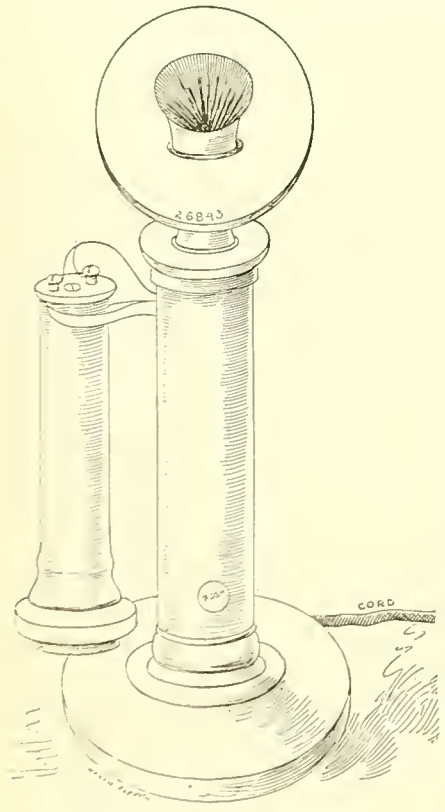
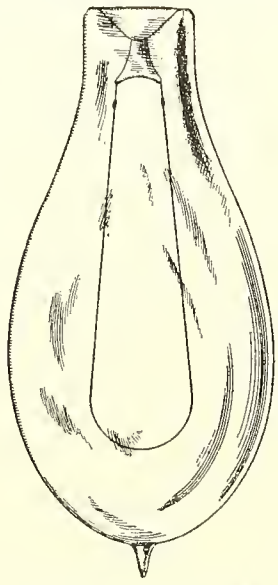


FIG. 1. MODERN EQUIPMENT OF TELEPHONE STATIONS.—EXTENSION DESK STANDARD.

which are in daily use in its factories. Here will be seen an automatic nut machine which forms a complete nut out of a roll of copper; also a screw machine which automatically performs on both ends of a single piece, and thereby saves a large amount of labor in handling. A multiple drill press is also shown, which drills a large number of holes at once. This machine is novel in that it is adjustable and permits all the holes being located anywhere within the radius of its table. Upward of thirty holes can be drilled at once with any size drill in any kind of metal and anywhere upon this table.

The main passageway separating the two spaces occupied by the company's exhibit is spanned by a large electrically illuminated sign. The sign is constructed of plate glass held by an iron framework, the words "Western Electric company, Chicago, New York, Antwerp, London, Berlin, Paris," being formed of colored glass. The sign is alike on both sides and inside is a rack of 14 2,000 candle power arc lamps, which is kept swinging back and forth across the glass letters by means of a small electric motor.

The Western Electric company also furnishes the lighting of the American Bell Telephone company's building, and



WARING INCANDESCENT LAMP.

has built and equipped the multiple switchboard in that building, which is the regular operating board for the World's Fair exchange. The trunk lines connecting this board with the main city office, about eight miles away, are in aerial and underground cables made by the Western Electric company. These cables are also used for the long distance service between the fair grounds and New York, Boston and other cities.

In making this exhibit it has been the intention to show something of the decorative effects produced by electric lighting, as well as the varied products of the company's manufacture.

Waring Incandescent Lamp.

During the last few months there seems to have been a general departure from the line of investigation heretofore pursued by lamp makers, and as a result many incandescent lamps have been introduced to the public which do not belong to the class known as vacuum lamps. The latest of these is the Waring lamp illustrated herewith. The inventor, John Waring, claims that it has been generally accepted by those familiar with the art that if the carbon of an incandescent lamp is not placed in a vacuum, even though it is surrounded by a gas which does not chemically attack the carbon, the "air washing," or rapid passage of the molecules of gas over the highly heated surface of the carbon, will produce a disintegration of the carbon. It has also been well known that if an incandescent carbon is surrounded by an atmosphere of hydrogen or nitrogen, the rapidly moving molecules of gas will carry off the heat from the carbon and thus require the expenditure of much more energy to keep the carbon in the desired state of incandescence. Accordingly it has been supposed that it was necessary to place the carbon in a nearly perfect vacuum, that is, in a sealed chamber having an interior gas pressure of only about one-millionth of an atmosphere.

Mr. Waring claims to have discovered that if a carbon in a sealed chamber is surrounded by a gas of great specific density, the dissipation of energy by loss of heat from the carbon is reduced, so that as a factor it may be ignored. By using as a surrounding medium a gas which has no injurious chemical effect on the carbon, the disintegration caused by high temperature is probably lessened and the blackening of the glass of the lamp is materially lessened, while the stability of the carbon is proportionately increased. As a result, it is claimed, a lamp is produced which will maintain its efficiency much longer than a lamp having its carbon in a vacuum.

These results, according to Mr. Waring, are best obtained by enveloping the carbon with a gas consisting of the vapor of bromine, or of the vapor of iodine, or of a mixture of both, the atomic weight of these elements being high. The gas may be generated by heat or otherwise, bromine, for instance, vaporizing easily, but iodine requiring heat. This gas, admitted to the globes and diluted by the air remaining in them, is then partially withdrawn and more gas allowed to enter, this process being repeated until the extent to which the desired gas is diluted with foreign gases has become practically infinitesimal. If preferred, the atmospheric air may be at first exhausted as nearly as possible and the desired gas then admitted around the carbon. The amount of gas to be admitted will in practice vary with the size of the inclosing chamber, with the nature of the gas, and probably also with the nature of the other elements of the lamp. The lamp is placed on the market by Claflin & Kimball, 11 East Adams street, Chicago.

Modern Equipment of Telephone Stations.[1]

By W. H. Hyde.

During the last few years a great advance has been made in the way of improving the talking efficiency of the lines and instruments used by the subscriber, so that at present it is possible for a Milwaukee subscriber, equipped with the modern long distance solid back transmitter and copper wire metallic circuit line, to talk with ease with subscribers at Chicago, Detroit, Cleveland, Pittsburg, New York, Boston and other points.

One of the most important of the improvements introtroduced in the service is the transmitter which is illustrated in Fig. 1. For the use of busy men who do not care to get up from the desk every time they are called, we have what is called an extension desk standard. This form of standard is purely a Milwaukee pattern, and is, I think, by far the neatest and most perfect yet designed.

When it was first suggested that some sort of desk set be offered, we sent for samples of the forms used in New York and Chicago, and found them not at all to our taste, being ungainly and not ornamental. Therefore the management ordered a special device designed for Milwaukee. The standard adopted is the outcome of this suggestion, the design being J. D. McLeod's, and the apparatus used in connection therewith comprising the best ideas of the other members of the company. In Fig. 2 is shown the

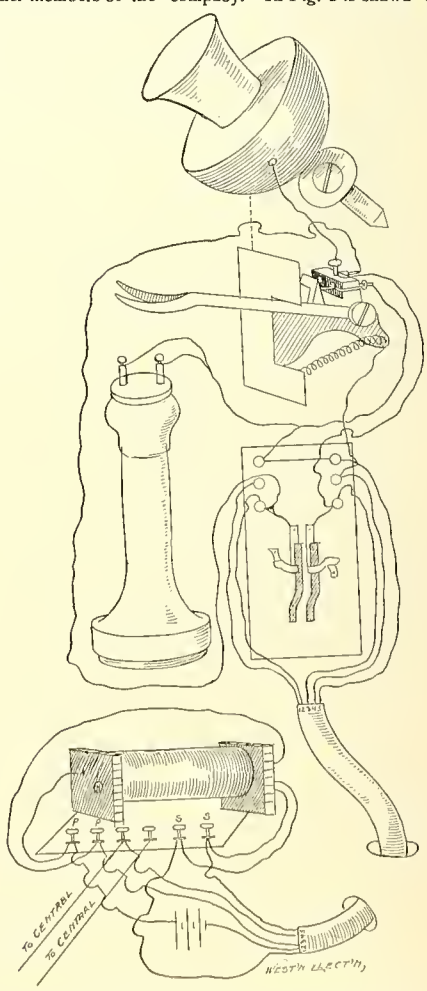


FIG. 2. MODERN EQUIPMENT OF TELEPHONE STATIONS.—DIAGRAM OF CIRCUIT—EXTENSION DESK STANDARD FOR LONG DISTANCE LINES.

standard together with a diagram of the circuit. The standard, I am pleased to say, has met with approval by all the progressive companies that we have sent samples to. A. S. Hibbard, formerly general superintendent of the Long Distance company of New York, now general manager of the Chicago Telephone company, Chicago, was very much pleased with it, as was also F. G. Beach, general superintendent of the Central Union company. Both of these companies have adopted this device with some slight modifications to meet peculiar requirements in their individual cases. The push-button on the side of the standard is used in connection with the Fuller battery, to call central.

1. Read before the Wisconsin Electric club, Milwaukee.

it only being necessary to push the button quickly two or three times, to throw the shutter at central. Most of the banks in the city are using this form of standard in connection with the regular wall set and quite a large number of business houses are also equipped with this little time-saver, and from all reports it is giving general satisfaction.

The regular long distance sets are furnished in two styles—the regular wall set with solid back transmitter, and the cabinet set, the latter being such as is used in public station booths.

The Fuller battery referred to, which is now generally used for all long distance work, consists of the outer cell, containing 6 ounces chloride of sodium, 1 pound sulphuric acid, 4 pounds water; and the carbon plate, and the inner cell, or porous cup, containing 4 ounces mercury, 3 ounces common salt and water to make the inner solution level with the outer solution, and the zinc well amalgamated. One cell will give the following results: 2 volts, 4 amperes (internal resistance at $\frac{1}{2}$ ohm).

Another important adjunct in the equipment of a metallic circuit, is the 1000 ohm bridging bell, the ringers of which are wound to 1000 ohms resistance, for the purpose of bridging out the current, so that it will divide up and pass through all the stations on a line. If the old form of 80 ohm bell were used, the first station on the line would get most of the current, and the others very little, if any. This arrangement is clearly shown in Fig. 3. This bell is also used on grounded circuit toll lines to improve the working of the lines, being bridged to ground, as shown in Fig. 4, instead of looped in as formerly, on the same principal as used in connection with metallic circuits. We have recently introduced a rather ingenious device in connection with this bell on some of our toll lines, as an experiment to see if it were possible to cut down the indiscriminate free use of our lines by our agents in the country, it being a very common practice for them to call up each other and use the line, and then upon a mutual understanding, not "check" the message. This, of course, is a loss to the company and greatly reduces the toll revenue.

The device referred to is very simple and consists of merely putting a bushing on the armature of the bell, which

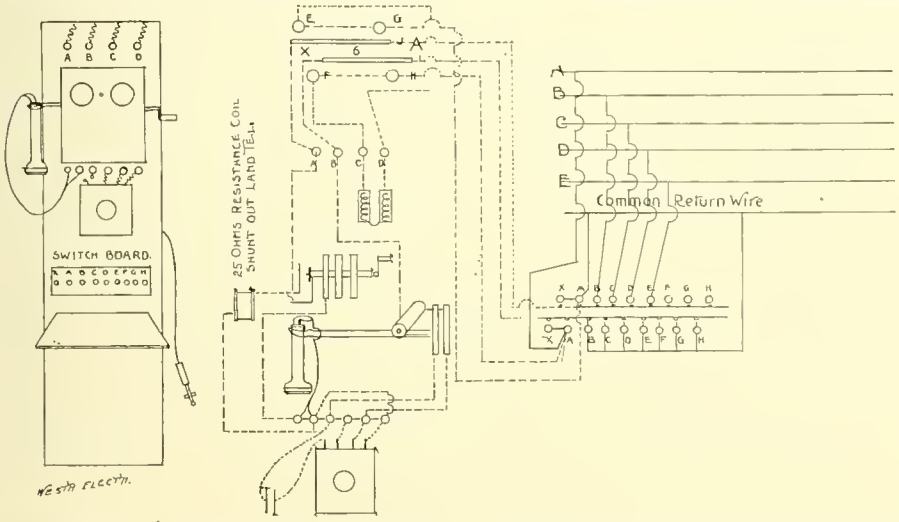


FIG. 5. MODERN EQUIPMENT OF TELEPHONE STATIONS.—AUTOMATIC EXCHANGE SYSTEM.

rotates upon a commutator and only makes contact on one side, thus changing the bell from an alternating to a continuous circuit bell. By this method toll stations on the same line are unable to ring each another's bells, but can throw a drop at the exchange where the line ends. The exchange operator then asks "What is wanted?" and upon receiving the name of station desired, rings on the line with an alternating generator and calls the station wanted. She then makes out a special check, charging up the message to the station that called, and at the end of the month the two reports must agree.

Another innovation is the automatic pay station. We have two of them in use in Milwaukee, one being at the telephone building and the other at the Union depot. The operation of these instruments is very simple, and consists merely of a number of bells of different tone to designate the amount of the coin dropped. The call for central is made in the usual way, and the operator asks what is wanted. She then gets the subscriber called, and before connection is made, calls back and says "fifty cents, please," or whatever the amount may be. The patron then drops in the required amount, which rings the 50-cent bell, the sound being transmitted to the operator via a funnel in connection with the transmitter. These machines are working very nicely and give no trouble whatever, as there is no complicated machinery to get out of order, and they do not require any more attention than the ordinary telephone.

I might mention one more feature, before closing, and that is the automatic switchboard. There are, I believe, at present, two different styles in operation, viz., the Strowger system for all sizes of exchanges from one to 10,000 subscribers and the Central Union Telephone company's system for small exchanges from 1 to 48 subscribers. The Strowger system is probably familiar to you all, as it has been recently described and illustrated. It is a remarkable invention in its way, and shows great ingenuity in its operation. It is worked on the units, tens, hundreds and thousands system; that is, each subscriber is provided with four push buttons, or something similar, together with a release key for disconnection. Desiring to call up anybody, say 286, the subscriber presses the hundreds button twice, the tens button eight times, and the units button six times. At the central office, each subscriber is furnished a little machine that connects with all the other machines, the mechanism being so arranged that as the pushes on the buttons are made, the machine of the subscriber calling automatically throws itself in connection with the subscriber's machine wanted. Should any member desire to study this system more carefully, I refer him to the WESTERN ELECTRICIAN of August 6, 1892, and November 12, 1892. On account of the complicated machinery necessary to operate an exchange of this kind of any magnitude, experts in the business say it will never be a successful commercial venture, although the idea has been carefully and wonderfully worked out.

There is an exchange of this kind, of about 50 subscribers, working at the present time at La Porte, Ind., and I understand that the system is constantly involved in mechanical troubles inherent to it, and that the projectors have had to keep an expert there all the time.

The other system referred to is very simple in its operation and is giving general satisfaction. Its operation is as follows: Say it is the intention to construct an exchange of 48 subscribers. Eight wires are run through the town and into each subscriber's office, six subscribers being placed on each wire. At each subscriber's station, in addition to his telephone, is a small switchboard, let into the backboard of the instrument, containing the necessary jacks to operate the eight wires. The subscriber's telephone ends in a plug, which is ordinarily kept plugged in on the line the subscriber is supposed to be called on, or in an answering jack provided for that purpose. Should he, however, desire to communicate with a subscriber on any of the other lines, he places the plug in on the line of the subscriber wanted and rings the required number of rings and gets his connection immediately. If the exchange is one through which a toll line runs, one of the subscribers is appointed the toll agent, and an extra jack is placed at his station. All calls for tolls are made through the agent, who, with the use of a pair of plugs and cords, makes the connection.

A common return wire is generally run, in addition to the eight wires mentioned, and all the subscribers, instead of being grounded, are connected with this wire, thus making the exchange practically a metallic one. As it will be readily seen, this system can only be used in small exchanges, on account of the cost of the additional wires and apparatus, and the inconvenience of the continuous ringing on busy lines. We are about to build a small exchange at Marshfield, Wis., where we will apply this system. The accompanying cut, Fig. 5, shows a diagram of the connections in this system. The construction of an exchange of this kind must, of course, be of the very best, to keep troubles down to the minimum. An expert is sent every three months to examine all the instruments and give them a general overhauling, thus greatly reducing the chances for trouble.

Complimentary Banquet to W. A Kreidler.

On Thursday evening, May 11th, a complimentary dinner was tendered to W. A. Kreidler at the Chicago Electric club by a few personal friends who desired to extend to him their congratulations upon his recent marriage. The banquet was served in the main dining hall of the club and was a thoroughly enjoyable affair. The following named gentlemen participated: F. B. Badt, E. Baggot, T. P. Bailey, J. P. Barrett, W. J. Buckley, J. B. Carney, W. Forman Collins, Seymour Coleman, F. W. Cushing, F. E. Degenhardt, E. C. Ferguson, C. E. Gregory, F. W. Horne, J. W. Johnson, W. E. Keily, M. A. Knapp, H. P. Lucas, J. B. O'Hara, F. W. Parker, W. B. Pearson, F. L. Perry, George B. Shaw, B. E. Sunny, F. S. Terry, A. S. Terry, Ben Williams.

During the evening Lieut. Badt, on behalf of the company, presented Mr. Kreidler a very handsome hall clock as a mark of esteem and friendship. At the conclusion of the dinner President Barrett called the company to order and named Congressman Shaw as toastmaster. That gentleman performed his duties gracefully and every member of the company was called upon for a response. The affair was informal throughout, and the evening will be remembered as one of the most pleasant events in the history of the Chicago Electric club.

Rapid Transit for Boston.

The rapid transit committee of the Legislature, to which Boston has been looking for relief from congested streets and slow street cars, has given the result of its winter's labors to the public. To an unprejudiced mind the committee's bill bears evidence of an earnest, intelligent study of the situation. The bill proposes an elevated road, to be built not along the lines of established ways but through a special street to be laid out between Washington and Tremont streets. The portions of the bill which are of more than ordinary interest provide that the governor may appoint three commissioners to have charge of the construction of the "L" road and providing better means for transit between the city and all its suburbs. The cities affected are Boston, Everett, Chelsea, Malden, Somerville, Cambridge, Waltham, Newton, Quincy and Medford; the towns are Winthrop, Revere, Melrose, Stoneham, Winchester, Arlington, Belmont, Brookline, Dedham, Hyde Park and Milton.

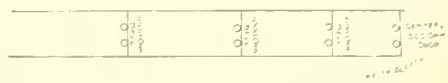


FIG. 3. MODERN EQUIPMENT OF TELEPHONE STATIONS.—BRIDGED METALLIC LINE.

The transit commissioners are to have full and exclusive power to grant and revoke locations for the use of the streets by the railways. The state is to issue bonds to the amount of $15,000,000 to defray the expenses of street widenings, etc., which is to be repaid by the city of Boston from rentals, taxes, etc.

The principal opposition that has arisen to this measure so far relates to the powers given the commissioners. Three members of the committee refused to sign the bill.

The commission is authorized to condemn a right of way from Causeway street to Dudley street, Roxbury, at or near Guild row, thence to Franklin Park, at or near Columbia street, the same to be not less than 25 feet nor more than 35 feet in width; Beverley street from Causeway street to a point at or near the corner of Endicott and Cross streets, thence including Cross street to the corner of Commercial street and Cross street, thence including Commercial street, passing the easterly side of the custom house to India street, thence including India street to Atlantic avenue, also widen Clinton street between its junction with said new street and Fulton street, Boyleston street from Tremont street to Charles street by taking a strip off the common, and making a sidewalk on the southerly side of Boyleston street at least eighteen feet wide; Court street from Bowdoin square and including Tremont row to Tremont street; Cambridge street from Charles street to Bowdoin square; Charles street from Leverett street to Beacon street; a new highway from Park square to point at or near the corner of Pleasant street and Eliot street, and from said point in as nearly a straight line as said commission shall deem practicable, including a part of Warrenton street to Broadway, at the corner of Curve street; a new highway from Causeway street, near Merrimac square, passing under Beacon street to Tremont street, using, if said commissioners deem the public necessity and convenience so require, the mall of Boston Common adjacent to Park street.

A subway bill has also been submitted, providing for a commission of three to lay out and construct a subway wide enough for four parallel tracks, with suitable approaches and exits. It shall extend through Tremont street from its junction with Pleasant street to Scollay square, and may go through Court street or other streets to a suitable point for connecting with surface tracks.

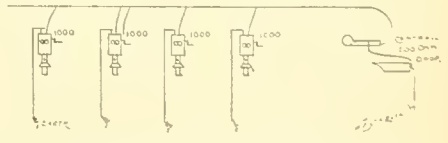


FIG. 4. MODERN EQUIPMENT OF TELEPHONE STATIONS.—BRIDGED GROUNDED TOLL LINE.

The city of Boston may issue $2,000,000 in 50 year 4 per cent. bonds for building the subway. When built the commissioners can compel street railways to use it at a rent to be fixed by the railroad commission. The subway commission may authorize use of the subway for pipes, wires or conduits at a rent to be fixed by them. After the subway has been in operation three months the commission shall be dissolved and the conduit shall be managed by the city.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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VISITORS

To the World's Fair are requested to forward their addresses to the WESTERN ELECTRICIAN as early as possible or notify us immediately upon their arrival in Chicago.

THE movement in favor of legal enactments compelling electric railway and cable companies to provide car shelters for motormen and gripmen during the winter months, lately commended in this journal, is spreading. The Ohio Legislature has passed an act of this character, and Minnesota will undoubtedly follow suit, if it has not already done so. Laws of similar purport should be on the statute books of all northern states.

NEW YORKERS are complaining of the humiliating position in which the city is placed in the eyes of the rest of the world through the attitude of the Rapid Transit commission in supplicating favors from the Manhattan company. But New Yorkers have only themselves to blame, as they did not possess enough public spirit to take advantage of the opportunity afforded them to construct an underground system of railways that would forever do away with the Manhattan monopoly. Having tamely submitted to the terms of that corporation, however, they will now be obliged to take whatever is given them.

THE formation of a company for the purpose of disposing of power generated at Niagara Falls is announced this week. It is proposed to transmit this power by means of electricity throughout the state. The project as outlined is a gigantic enterprise and its development will be watched with interest. Should the plans of the company be found practical, the project will form the most important power transmission scheme ever undertaken. There is, of course, no doubt that the power can be distributed by electricity as proposed, but the economical features will have to be carefully studied and determined. At Rochester, for instance, one of the points to be supplied according to the present plans, there is an excellent water power which is utilized by the local electric company. It is therefore questionable if the Niagara company can transmit power to the Flower city and compete with the local company which is operating under favorable conditions.

ANOTHER incandescent lamp in which gas is introduced has been placed upon the market. The new lamp is the invention of John Waring and his claims are presented in detail in another column. Mr. Waring claims to have discovered that if a carbon in a sealed chamber is surrounded by a gas of great specific density, the dissipation of energy by loss of heat from the carbon is reduced, so that as a factor it may be ignored. By using as a surrounding medium a gas which has no injurious chemical effect on the carbon, the disintegration caused by high temperature and the blackening of the glass of the lamp is said to be materially lessened, while the stability of the carbon is proportionately increased. As a result, it is claimed, a lamp is produced which will maintain its efficiency much longer than a lamp having its carbon in a vacuum. These results, according to Mr. Waring, are best obtained by enveloping the carbon with a gas consisting of the vapor of bromine, or of the vapor of iodine, or of a mixture of both. The appearance of this lamp at the present time is significant as indicating the direction which investigators are following in their efforts to produce a perfect incandescent lamp.

LAST week the public was given two opportunities to witness the beauties of the World's Fair in the evening, and the attendance was so large that the directors will undoubtedly see the wisdom of opening the gates every evening after, say, the 1st of June. As pointed out by this journal at the time of the agitation against the evening closing rule, this is the only reasonable course, both in the interest of the exposition at large and in justice to the electrical exhibitors. When the electrical illumination and embellishments are complete, the World's Fair grounds will present a scene of surpassing beauty at night, and there is no valid reason why the exhibition should not be open every evening. Of course the electrical fraternity is a unit in favor of opening the gates in the evening, and undoubtedly the trend of public sentiment is in the same direction. The *Record*, one of the most influential of Chicago journals, has this to say on the subject:

After that great display at the World's Fair grounds Saturday night, the advisability of holding these evening fetes very often is more apparent than ever. Despite one or two hitches in the arrangements, the spectacle presented by the grand court of honor and the perspective views to be seen throughout the grounds were marvelously beautiful. Even the dullest mind and the slowest imagination could not have remained passive before the striking exhibit of glowing temples, moving crowds and distant music. It was one of those rare sights before which it is unnecessary to work one's self into emotions of admiration, simply because it compelled admiration, instant and spontaneous.

Such was the show that thousands of people turned out to see, and their eagerness to come is in itself a demand that the fair be opened at night whenever practicable. Even from the comparatively low standard of purely commercial reasons, the best interests of the Fair require a compliance with this popular wish. The first fete has proved a brilliant success. There should be many more like it.

It will be remembered that the rule on the subject, as it now stands, is that the exposition shall be open after 7 P. M., only on the occasion of "special evening entertainments." When the matter was brought forcibly to the attention of the directors as the result of the agitation begun by the WESTERN ELECTRICIAN, President Higinbotham interpreted the rule to mean that the fair would be open from three to six evenings a week. While this question, like the Sunday opening problem, is not yet definitely settled, there is good reason for the belief that, when everything is running smoothly, the public will be admitted on the evening of every week-day, at least. This should dispose of the matter to the satisfaction of all concerned.

ADVICES from New England show that the fight between the electric and steam railways is not altogether one-sided, and that while the powerful lobby representing the steam railroads in the Connecticut Legislature was able to control the Senate, the friends of the electric railway mustered enough independent members of the lower house to defeat the legislation proposed in the interest of the steam roads. The present controversy has been occupying public attention in New England since the publication of the last annual report of the state railroad commissioners. This report was practically a plea for the steam railroads. It was called out by the proposed extension of several electric lines and the establishment of new ones, which would comprise an extensive system connecting several important cities and giving easy access to summer resorts. Formerly this business had been controlled by the steam roads, but their service was poor, rates were high and in many cases the inhabitants of quite pretentious towns could reach desirable summer resorts only at considerable cost and great inconvenience. Naturally, the people welcomed the electric railway, but the managers of the steam roads did not wish to relinquish their control. Following the report of the railroad commission a systematic plan of securing legislation adverse to the electric companies was followed. The powerful railroad lobby also opposed every bill that contained any features that might be favorable to the electric system. This opposition may yet prevent the passage of the pending bill relating to the organization and powers of the proposed electric railroad companies. The steam railroad companies have exercised their influence successfully in the Senate, where the provisions of the bill have been so changed that the House, which is inclined to favor the electric companies, cannot be induced, it is said, to accept it. For this reason there may be no legislation on this question, owing to the failure of the House and Senate to agree upon a bill. The projected new electric roads and extensions of existing city lines would be of great service to the residents of the city and of the suburban districts, but the opposition of the steam companies to the granting of privileges that may affect their traffic injuriously cannot easily be overcome.

ABOUT two months ago the New York Legislature appropriated $10,000 to defray the expense of conducting experiments in propelling canal boats by electricity. At the present time several projects are under consideration and it is hoped that a practical scheme will be evolved that will prove commercially successful. One of the most promising plans submitted is that of a Buffalo engineer who has worked out the details of a very elaborate system. This scheme in some respects follows the general line of the trolley system of street railways. Power plants will be constructed at regular intervals along the route of the canal, from which current will be supplied by an overhead trolley system to the boats. Three trolley wires will be suspended over the bed of the canal and these will be so adjusted that allowance will be made for a boat departing from its regular course. This, of course, would be necessary in order to allow boats to pass each other and make turns and stops at docks. In the stern of the boat will be placed a motor to drive the screw which will propel the boat.

The same considerations which have led to the substitution of the electric motor for animals upon street railways apply to the propulsion of canal boats by electricity. At the present time, it is the practice to provide accommodations for horses upon the boats, and this means that much valuable space is devoted to stalls and feed bins which could be utilized to advantage. But much more important than mere commercial advantages are the sanitary considerations which should influence the legislature in adopting an electric system. There is no doubt that the presence of horses and mules on the boats is not conducive to good health, and the practice of throwing refuse from canal boats into the sluggish stream is reprehensible. Under the present conditions, however, it is certainly almost impossible to enforce sanitary regulations. New York has a fine waterway in the Erie canal which, if equipped electrically, would be greatly enhanced in value, and would prove an important factor in regulating freight rates. It is to be hoped that the present movement will be followed up until the proposed system shall have been given a fair trial.

Death of A. W. Meston.

A. W. Meston, superintendent of the Emerson Electrical Manufacturing company, St. Louis, died of consumption at his home Friday night, May 12th, after a lingering illness of several months. He had recently returned from a trip to Jamaica in company with E. J. Bagnall. This trip had been taken upon the advice of H. L. Parker, president of the company, and several friends, with a view of benefiting his health, but it proved to be of little benefit, for since returning home about five weeks ago he had been confined to his room or bed almost constantly until his death. Mr. Meston was born near Edinburg, Scotland, twenty-six years ago, and came to this country at the age of fourteen. During the past eight years he had lived in St. Louis, during which time he took a short course in electrical engineering at Washington University. In 1890 he left the university and engaged in the manufacture of electrical apparatus in a small way, in which venture he was associated with his brother, Charles R. Meston. This venture resulted in the organization of the Emerson Electric Manufacturing company in October, 1891, of which he became superintendent and engineer.

Mr. Meston was a close student in electrical matters, both in the university and in the practical work in which he afterward engaged. His special study was that of alternating current motors. His work in this field will probably always be recognized as that of a pioneer, and resulted in one of the first and most successful alternating current fan motors on the market—the Meston alternating fan motor.

Mr. Meston was only twenty-six years of age, hardly yet in the prime of life. Although never strong in constitution he was always a hard worker. His unflagging zeal was almost self-sacrificing until, too late, he was compelled to desist and seek rest. Personally he was a most excellent gentleman, always kind and courteous, yet frank and outspoken with every one. He was a member of the St. Louis Electric club, but owing to late illness he had been unable to take much interest in its active work.

Controversy Over Blue Prints.

No further developments of a sensational character have been published during the week in the controversy between the Westinghouse and General Electric companies over the blue prints which the former charges the latter with having secured through unlawful methods. A dispatch from Pittsburg of May 10th says:

The hearings of Morris W. Mead, superintendent of the city bureau of Electricity, and others charged by the Westinghouse company with conspiracy to purloin blue prints of the Niagara contract from the office of the latter concern, was called this afternoon. All of the defendants, through their attorneys, waived the preliminary hearing and gave bail for trial at court.

The Westinghouse company issued an official statement immediately after this proceeding, reiterating its charges and disclosing that it had in its possession ample proof to sustain them.

William R. Rankin of New York, secretary of the Cataract Construction company, says that corporation is in no way interested in the controversy between the Westinghouse and General Electric companies, and that its division would in no way be affected by the present litigation.

In an interview telegraphed from Pittsburg, District Attorney Burleigh denied a statement in connection with the alleged electrical conspiracy which has been published in New York papers. The story was to the effect that immediately after the arrests in Pittsburg young Ashton, one of the defendants, had gone to Mr. Burleigh and made a full confession of his part in the alleged plot of the General Electric company to steal Westinghouse plans from the main office. Mr. Burleigh says that this story has no foundation whatever, and in his official capacity he has had nothing to do with the case so far. "I do not know Ashton," said the district attorney, "and he has made no confession, so far as known, nor has anyone else. The case up to the present time is in the hands of the private counsel of the electric companies. No papers that I know of have been prepared for the grand jury."

Transmitting Power from Niagara Falls.

A dispatch from Niagara Falls says: "It is understood that a contract has been made between the Niagara Falls Power company and the Cataract Electric company of Rochester, N. Y., by which the former is to furnish to the latter any part of twenty-five thousand horse power of electric energy as soon as the transmission line can be laid from Niagara Falls to Rochester. This power is generated by the waters of the Niagara river passing through the great tunnel which has just been completed." The route will be laid along the line on which the greatest demand is made for power. The distance between Niagara Falls and Rochester is more than 70 miles, and the experiment of transmitting 25,000 horse power this distance will be watched with considerable interest. It is also the intention of the Niagara Falls Power company to furnish power to Buffalo, Tonawanda and Lockport.

Driving Calico Printing Machines by Electricity.

In a recent paper read before the New England Cotton Manufacturers' association C. J. H. Woodbury of Lynn described the successful application of electric power to the printing machines at the Dunnell Print Works in Pawtucket, R. I. He said: "The operation of a calico printing machine presents the greatest difficulties in the application of power of any machinery in textile manufacture. The machine must be driven at will with variable speed, and any shock in the gradations from one speed to another may impair either the machine or the product. The cloth must be moved at times to a slight extent in either direction, and the whole must be absolutely under the control of the operator. Up to the present time a double cylinder steam engine to each machine has furnished the best method of driving, notwithstanding that the heat and the floor area occupied by the steam engine are necessarily an interference in the printing room. When the printing machine stops the rolls sink into the blanket, and it requires an excess of power to start it, as if it were a heavily loaded team on a soft road. The recent application of electric motors has given practical results of the greatest importance in operating printing machines at the Dunnell works. This work was undertaken in the face of the opposition of the men at work in the printing room. There were some difficulties, primarily owing to the fact that the electricians were not skilled calico printers, as well as that the printers were not electricians. It required a little time for each to learn of the other. However, since several modifications in the system were introduced, the operation has been not merely satisfactory, but has given results in advance of any other method of driving a printing machine. This is the first practical use of motors for such purposes."

International Congress of Electricians at Chicago.[1]

By E. Hospitalier.

The provisional programme proposed for the International Congress of Electricians in Chicago in 1893 by the American Institute of Electrical Engineers of New York, has borne fruit. Approvals and criticisms elicited by the programme have shown the value of opening in advance a discussion which is to be settled by the congress in the form of clearly expressed decisions and votes. At the present time when everything or nearly everything has been said upon points of detail, in a rather desultory way it is true, it seems opportune to consider the matter as a whole systematically and methodically, by examining each question in its logical place, and by following the natural order of the successive definitions, which have led to the C. G. S. system. In the following discussion we shall consider only the quantities and units of the C. G. S. system based upon three fundamental measurements, length, mass and time, and their respective units, centimeter, gramme and second. Certain writers still use the phrase "absolute system," but it should be discarded, as it does not sufficiently designate the C. G. S. system. There are many absolute systems of which the C. G. S. adopted by the International Congress of Electricians in 1881 is only one.

The formation of new physical quantities, their names and their units has heretofore been intrusted to the caprice and fancy of writers, and thus it is not unusual to find many definitions of the same physical quantity or unit, or even what is even more serious, the same name applied to several quantities and to absolutely different units.

Is it not possible to do for physics what a century ago Guyton de Morveau did for chemistry, and has not the time come for a congress to define the general rules that should control the naming and defining of quantities and units? If after such modifications as are deemed useful, these rules receive the sanction of the congress, they will greatly simplify the work of future congresses, for it would be sufficient to apply them vigorously to create, automatically, so to speak, the new quantities and new units rendered necessary by the incessant progress of the science and the art.

We shall not assume to formulate the rigid principles and absolute rules which should prevail, but it seems worth the while to lay out the rough canvas upon which more competent and skillful savants may work their graceful arabesques.

Every physical quantity that is distinct from every other physical quantity must be designated and clearly defined once for all in the following respects:

1st. A special name.
2d. An international symbol.
3d. An equation of definition in terms of the fundamental quantities or other derived quantities.
4th. A C. G. S. unit, and for such as are frequently used a special name with corresponding definition.
5th. One or more practical units, multiples or decimals of the C. G. S. unit with corresponding abbreviations, as otherwise the C. G. S. unit and the practical unit would be confused. When the physical quantity admits of standards they should be added.
6th. A fundamental standard for scientific investigations and work necessitating great precision.
7th. A practical standard adapted to the needs of the art.

1st. *Name of Physical Quantities.*—A specific designation is necessary for each physical quantity, but it is not always essential that this name should be a single word. It will be advantageous to adopt rules to govern the designation of new quantities required by practice. We propose to add to physical quantities connected with length the terms respectively linear, superficial or sectional and cubic or volumic to indicate what new quantity is in question; *e. g.*, the linear capacity of a submarine cable, the quotient of its capacity by its length, will be measured in microfarads per kilometer, while the linear insulation of a line, the product of its insulation resistance and its length, will be measured in megohms per kilometer.

The words "kilometric capacity" and "kilometric insulation" possess the prime inconvenience of defining the quantity by introducing a particular unit, the kilometer, while only physical quantities should appear in the definition of a physical quantity.

The energy embraced in a dialectric or a magnet and that dissipated by hysteresis is, in the case of uniform electrization or magnetization, proportional to the volume of the substance considered and to a certain factor to which we have heretofore given the name of specific energy, and which is expressed by $\frac{W}{V}$ where W is the energy and V is the volume. With the rule, which we propose, specific energy would be simply the cubic or volumic energy.

It is understood, of course, that these rules would be applied only in cases where new words were to be formed and that, to cite an example, the quotient of the mass of a body by its volume would preserve its name of density, instead of being called the cubic or volumic mass.

We would wish to go still farther, and find terms to designate physical quantities connected with mass and time.

We wish especially, in proposing rules for forming new physical quantities, to avoid in the future those fantastic definitions, for which the English have been so often responsible, and which consist in writing in a definition physical quantities and units, whereas there should enter into a definition of a physical quantity only physical quantities.

It is illogical to say that speed is a length per second, that power is work per second, that specific resistance is resistance per square centimeter, that magnetic induction is a number of lines of force per square centimeter, that the frequency of an alternating current is the numbers of periods per second.

2d. *Symbols.*—Each physical quantity should be represented in a formula by a particular symbol always the same and adopted once for all, in order that the reading of equations may be facilitated and simplified. The systematic use of italic letters and Greek letters was recommended by the Frankfort Congress in 1891; it remains to establish an international agreement for the definitive adoption of these symbols. We shall indicate later, those which seem to us to have the best chance of adoption.

3d. *Definition Equations.*—In a coherent system of physicial quantities each of them is deduced from those previously defined in a simple equation, which constitutes the algebraic expression of the definition. It is easy to deduce from it the equation of the corresponding equation of dimension by substituting dimensions for each of the quantities that appear in it and by simplifying the expression.

4th. *C. G. S. Unit and Abbreviation.*—The C. G. S. unit of a derived physical quantity is deduced from the equation of dimension by making all its terms equal to a C. G. S. unit. This is the invariable and universally applied rule, and it is unnecessary farther to consider it. It may be useful in practice, however, to give special names to certain of these units which are in frequent use, several magnetic units in particular, as has been done in the case of the dyne and erg.

When the unit is composed of two others it is the rule to unite them by a hyphen if the two units are multiplied, and to separate them by the word "per" if the units are to be divided. (Ampere-hour, watt-hour, meter per second, watts per candle.) The abbreviations of these C. G. S. units will be Roman letters in accordance with the vote of the Frankfort Congress, the abbreviation being formed by the first letter or the first few letters of the name itself.

5th. *The Practical Unit and Abbreviation.*—The practical unit adopted for the measure of a physical quantity will be defined as a multiple or a decimal of the corresponding C. G. S. unit. Abbreviations of practical units will be formed and written in accordance with the rules hitherto mentioned as governing the formation of the C. G. S. units.

6th. *Fundamental Standard.*—Every fundamental standard which serves as the common measure for given physical quantities should be either a copy, as exact as possible, of an accepted standard (meter and kilogramme in the archives), or it should be defined with such precision that it can be reproduced without error or ambiguity.

The Chicago congress in dealing with the matter will be obliged to define two important fundamental standards, one of resistance and one of electromotive force, but to avoid confusion with corresponding standards defined by former international congresses and conferences, it will be necessary to add to each of the standards thus defined a characteristic designation, such as Chicago ohm, ohm$_{93}$, ohm$_{100.5}$, etc. The name ohm without designation should be reserved for the practical C. G. S. unit, which is defined as being equal to 10^9 C. G. S. units.

7th. *Practical Standard.*—It seems difficult for a congress to reach decisions relative to the adoption of practical standards for the measure of physical quantities

1. *L'Industrie Electrique.*

The electrodynamic balance of Lord Kelvin and the ampere standard of M. Pellat constitute true standards for the measure of current strength; a certain number of voltaic combinations give electromotive forces sufficiently constant and of potential well enough known to constitute standards, but their more or less general adoption is a question of detail not within the jurisdiction of a congress. We thought it worth while to call attention to the importance of the matter, but not with a view of urging an international agreement on this score.

Duplex Electric Sinking Pump.

The difficulties heretofore encountered in obtaining an electric sinking pump, light in weight, compact in form, of good capacity and efficiency, and not liable to damage from moisture or hard usage, have been to a great extent overcome in the pump here illustrated. The motor with gearing and operating mechanism is entirely contained in a cast-steel casing, absolutely water-tight. The pumps are of the duplex double acting type, with outside packed plungers. The only moving parts visible are short sections of the plungers and rods. All wearing parts are readily accessible for examination and can be quickly and easily replaced. This pump is not susceptible to damage from water, and its form is such that it will stand considerable hard usage without injury. It will work as well under water as out of it. If, therefore, the precaution is taken to use thoroughly insulated cables for conveying the electric energy to the pump, it may be "drowned" by a sudden rush of water in the mine and still continue operating. This pump is economical in the use of power and has a very high efficiency. It has a capacity of 125 gallons per minute against a vertical head of 200 feet; occupies a space of only 24 inches by 26 inches by 86 inches, and weighs complete 3,000 pounds. Pumps of this type are manufactured in various sizes and are put on the market by the

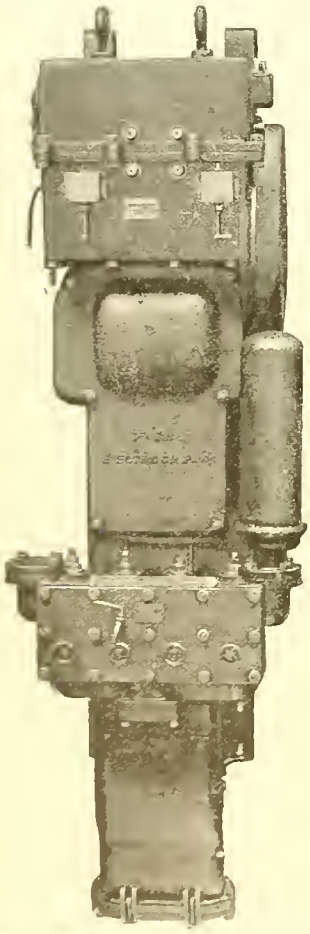


FIG. 1. DUPLEX ELECTRIC SINKING PUMP.

General Electric company of Boston and New York.

Fig. 1 shows a front view of the pump. Fig. 2 represents a side section.

The Stanley-Kelly Motor.

To the Editor of the WESTERN ELECTRICIAN.

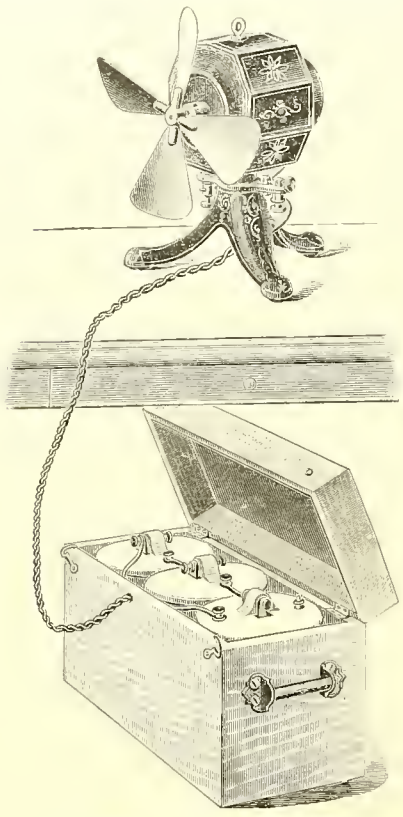
In connection with the article in your issue of the 29th ult. allow us to say that throughout the development of our system we have received great aid from all our associates, and that we are indebted to them for valuable suggestions, especially so to C. C. Cheaney and W. B. Tobey.

WILLIAM STANLEY, JR.,
JOHN F. KELLY

The Macon Electric Railroad company, Atlanta, Ga., will build a line five miles long from Atlanta to the United States barracks.

New Ironclad Battery Fan Motor.

The fan motor illustrated in the accompanying cut, has been designed with special reference to primary battery operation. The friction of its armature bearings and brushes has been reduced as far as practicable, so it may run a 7-inch four-bladed fan at 1,000 revolutions per minute, with 2 amperes and 1.5 volts at the terminals. The battery consists of three Edison-Lalande cells, enclosed in an oaken box. The capacity of one charge in this battery is 150 ampere hours. The armature is entirely enclosed in an iron box or ornamental field frame, with a glass window at one end, through which the brushes and commutator may be inspected.



NEW IRONCLAD BATTERY FAN MOTOR.

The Edison Manufacturing company, 110 East Twenty-third street, New York, manufactures these motors.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 13.—Pending the settlement of the moot point whether engine No. 999 really did travel a mile in 32 seconds, the Broadway company has begun its final series of experimental tests on its road bed and cables, and expects by June 15th to remove all its horses, and give New Yorkers quicker traveling along their principal thoroughfare than they have ever yet enjoyed. The speed of the cable cars is to be limited for a while to six miles an hour, but as soon as the gripmen have graduated in the school of instruction that has been established for them, and are thoroughly familiar with their duties, it is proposed to put the cars along at a lively gait. The rolling stock will comprise 186 new cars. An interesting problem offering itself for solution now is how long, judging by what is taking place in other parts of the country, will it be before the new line is worked by electricity? The cable engineers do admirable work and pave the way for a good electric conduit system.

The negotiations between the Rapid Transit commission and the Manhattan Elevated company are proceeding leisurely. The action of the commission is severely criticized. Although it has in its hands the disposal of a valuable privilege, which the Manhattan Railway company may reasonably be regarded as anxious to secure and to pay well for, it is allowing itself to be put in the position of a supplicant, while it permits the company, which is in reality asking for the privilege, to dictate its own terms. As a leading daily has pointed out, the commission has practically put itself in the position of supplicating favors at the hand of the Manhattan company by abandoning all other means of doing anything for rapid transit. It recognizes the necessity of doing something, and it has virtually admitted that it can be done only through the elevated railroad monopoly. But the city is not wholly dependent upon the Manhattan company. Further transit facilities, even by elevated roads, if that is a necessity, can be obtained without it. Reasonable requirements should be insisted upon, and if they are not accepted, an alternative plan should be adopted and offered for competition. If the Manhattan will not take the present opportunity, which it does not deserve, it should be turned over to somebody else.

Great interest centered on the General Electric stock on the opening of the market on Monday morning on account of the litigation between it and the Westinghouse company. The stock fell 7 1-8 points in the first fifteen minutes, but recovered somewhat before the close of the day. On Wednesday it ran down to 70½ in the face of a very explicit statement by President Coffin that there was no foundation for the rumors that the company is in danger of reorganization, because of insufficient cash resources to to meet its floating debt. Mr. Coffin added that the cash which the company now has on deposit is greater than its entire maturing obligations for the next sixty days, including interest and dividend, and that its obligations and those of its underlying companies have been decreased more than $2,000,000 since the annual statement at the close of the fiscal year; that it has over $4,000,000 unfilled orders on hand, which were all practically taken for cash, and that it is taking no bonds and stock in payment for apparatus as currently reported. To these assurances, which were sent at length over the tapes, was added the further statement that the company was in a perfectly easy financial condition. The stock closed to day at 73, and the chances are that it will exhibit no considerable fluctuation for some time to come.

It is satisfactory to know that in spite of the financial embarrassments of Erastus Wiman, the prospects of the electric light plant at Livingston, Staten Island, which figured so prominently in his assets, are not likely to

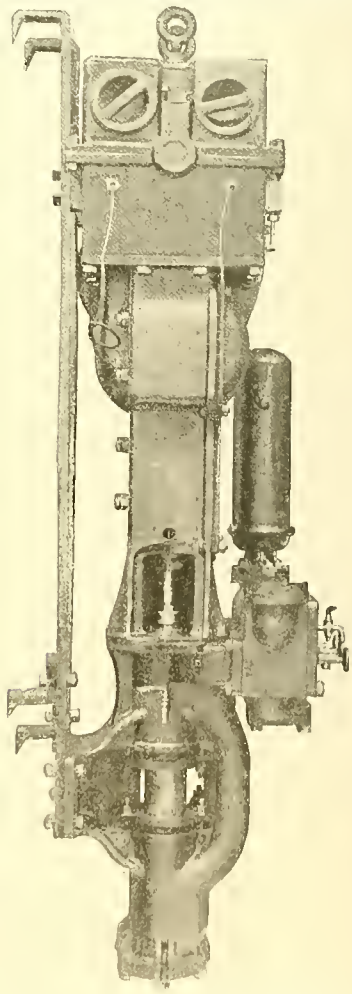


FIG. 2. DUPLEX ELECTRIC SINKING PUMP.

suffer. About $170,000 has already been sunk in the undertaking, and about $130,000 more will be needed to put it into working order. But a large business has already been built up on the island. A considerable demand for power for manufacturing purposes and a large demand for electrical energy to operate electric roads on the island justified the expenditure of a large sum for the Livingston plant, which is now nearly completed. It is asserted that with the cooperation of the company's creditors it will be quite possible to extricate it from its present difficulties. The completion of the plant will be essential to the recovery of the amount invested, and it is said that there is sufficient profit in the business at St. George to

pay the interest on the money necessary to complete the works. The receiver thinks that a satisfactory arrangement will be made with the creditors, and says there is no reason for any anxiety on the part of the Staten Islanders, as the light will be furnished as heretofore.

The attorney for the Thomson-Houston company here has been interviewed in regard to the suit brought by that company to restrain the Winchester Avenue & West Haven Electric railroad company and the Westinghouse Electric company of New York and Pittsburg from operating an electric trolley railroad. This suit is for infringement on a trolley patent taken out by the Thomson-Houston company April 11th. It is a test case which was decided on long before the patent was granted, and the Thomson-Houston company is now pushing it in accordance with a pre-determined plan and quite independently of the trouble between the General Electric and the Westinghouse Electric companies. The patent granted to the Thomson-Houston company is claimed to cover two parts of the trolley now used on the roads equipped by the Westinghouse Electric company. It will probably be a month before an answer is filed by the Westinghouse company and the New Haven company, and it may be three or four months before a preliminary hearing is reached.

A syndicate with $4,000,000 capital was formed in this city yesterday to construct and equip an electric transmission line from Niagara Falls to Albany. The route of the line has not been fully determined upon. It is, however, expected to supply the cities, towns and villages on the way with electricity for light, heat and power. Central stations are to be built at various places, from which current will be distributed. The syndicate is said to represent interests allied with those concerned in the construction of the Falls tunnel.

The trouble between the striking electric linemen and the Brooklyn City railroad was amicably settled on the 11th inst. It was agreed that the men should receive $3 a day according to their demand. Those of the strikers who had obtained work in other cities were notified and returned to work. No agreement has been reached between the union and the Citizens' Electric Lighting company.

The strike among the linemen of the New York & New Jersey Telephone company continues, and fifteen more telephone linemen, employed by the company in Staten Island, went out on a strike two days ago for an advance from $2.50 to $3 a day.

Dr. Cyrus Edson sends from Washington some news that will be gratefully received in Chicago. He went to Washington to find out if the government authorities have more information about the cholera than is obtainable in New York. He says: "Their advices are of the same tenor as ours, and are very reassuring. There is no cholera in Europe now, except in Russia, and the outlook is good that we will not have a visitation of the scourge this year." Dr. Edson sees further cause for satisfaction at this prospect from the fact that "the presence of cholera in the United States this year would be a tremendous misfortune. It would mean the collapse of the World's Fair and the financial ruin of thousands." W. F. O.

New England Notes.

BOSTON, MASS., May 13.—The storage battery petitioners, who ask for the use of the tracks of the West End street railway, have again demonstrated their strength in the Legislature. The bill giving them this right was passed to its third reading by a large majority. William S. Hall, one of the petitioners for the incorporation of the storage battery company, president of the Hopedale Electric company, which controls the patents of the Milford & Hopedale Street Railway company, reports concerning a month's trial of the Milford cars, that "for thirty days our cars ran on an average over 200 miles per day. To propel these three cars we used five batteries, and the total cost of running each car per mile was 19.34 cents; to this we add 7-10 of a cent per car mile for taxes, insurance against fire 27-100 of a cent per car mile, insurance against accidents 34-100 of a cent. per car mile, damages not covered by accident policy 27-100 of a cent per car mile. This makes the total cost per car mile 20.92 cents. The same cost on the West End road for the year ending September 30, 1892, was 27.42 cents per car mile, and the average cost per car mile on all the street railways of the state was 25.19 cents per car mile. We have operated our cars for two years giving uninterrupted service all the time including Sundays. They have frequently been loaded to their maximum capacity, but this has never caused any trouble even on the ten per cent. grades. We have carried upwards of 280,000 passengers without an accident." In the face of these statements Prof. Dolbear of Tufts College and other electrical experts state unqualifiedly that the storage battery can not be made a commercial success in the operation of street railways. The city of Ansonia, Conn., which has become interested in the matter, has sent a committee to examine into the operations of the Milford road and report if it is a commercial success. One member of this committee is a Trinity College professor.

The fight made in the Connecticut Legislature by the steam roads against their electric rivals has taken a decided and unexpected turn in favor of the latter. On May 3d, the House of Representatives amended almost beyond recognition a bill passed by the Senate for the regulation of electric street railways. The chief feature of the bill as it came from the senate was a provision prohibiting the paralelling of a steam railroad by an electric street railway without the permission of the railroad commissioners, and also forbidding electric roads to carry freight. The action of the house came as a result of a reaction against the high handed methods of the steam companies, who were attempting to thwart legitimate enterprise and prevent competition. It is understood that the Senate will maintain its position, in which case the success of the numerous street railway companies which have applied for charters will be endangered.

The Legislature has at last produced something as the result of its long continued series of hearings, which looks as if an intelligent attempt were really to be made to solve the rapid transit problem. The committee on railroads has reported a bill providing for the erection of a gigantic union station for the railroads entering Boston on the north and east. This, in fact, was what the Boston & Maine company was contemplating, but the Legislature has embodied a feature that goes far beyond anything that has been proposed by the railroad companies. This station is to be an elevated one and built so as to enable passengers to be transferred direct to the cars of an elevated street railroad, should such a road be built. And were it not probable that such an "L" road were to be built one can be sure that such a provision would not have been included. The three stations now operated and used by the Boston & Maine company and the section of the Fitchburg railroad are to be consolidated. The plan is elaborate in its details. It provides that the Boston & Maine company shall do the work. In compensation for the accommodations the Fitchburg company is to receive a satisfactory rental which it shall pay for these privileges. The commonwealth and the city of Boston are also included, for it is provided that the commonwealth shall from time to time, as the work progresses, pay over to the Boston & Maine company 35 per cent. of the outlay it has made. Of this 35 per cent., the city of Boston is to pay the commonwealth two-sevenths or 10 per cent. of the whole cost. The penalty for refusing to build this station is set at $500,000 with $5,000 a month additional penalty for neglecting to submit plans for the approval of the railroad commissioners. The plan also includes a complete rebuilding of the various railroad bridges and draws over the Charles river. All grade crossings are to be abolished. The estimated cost of the whole project is $7,000,000. But the railroad people say it will cost several millions more than this figure.

The legislative committee on mercantile affairs gave a public hearing on the matter of underground wires on Monday evening. There was a lively discussion, and many of the companies affected were represented by counsel who took strong ground against the bill to create a separate commission with the most arbitrary powers. The companies represented were: New England Telephone company by S. L. Powers, Edison Electric Light company by J. C. Wardwell, Massachusetts Electric Light association by E. W. Burdette, Boston Electric Light company by E. W. Burdette, Mutual District Messenger company by D. J. Hearn. Beside these President F. A. Gilbert of the Boston Electric Light company and F. A. Houston of the New England Telephone company were present. The representatives of the electric companies criticised the bill because it gave unlimited authority to the commissioners who are to superintend the removal of the wires, and is to take effect all over Boston at once, instead of specifying certain parts where the wires might be removed from time to time. They object to the companies being dictated to by a commission, only one member of which knows anything about such business. The bill would not affect at all a great number of overhead wires such as the burglar and police alarm systems and numerous private wires.

The Worcester board of aldermen has imposed the severest conditions ever known in New England in granting franchises for electric street railways lately. The State Central Street Railway company has the past week been given permission to build in three streets to the Shrewsbury line provided it paves one of these streets for half a mile its full width and macadamizes the other two streets. It is also required to widen the bridge over the Boston and Albany railroad, and also a causeway across the lake. Several other franchises have been granted with conditions in most instances requiring either the complete paving of streets or macadamizing. All such franchises must be accepted in 30 days.

The new municipal electric lighting plant of the town of Peabody has been turned over to the town authorities. The total cost of the plant has been nearly $50,000. The building is of brick and put up according to mill construction with a granite foundation. The boiler room contains two 125 horse power tubular boilers. The capacity of the engine is 150 horse power, which is about half as much again as is required at present. Four Edison arc dynamos are in use provided with Schuyler regulators. The town is thus wired in four circuits, each dynamo being interchangeable on the circuits and independent. Forty miles of wire are used in lighting 23 miles of streets.

The tracks of the Brockton street railway are to be extended to East and West Bridgewater and Bridgewater this spring. All the stock has been subscribed for to make these extensions. The road now takes in Brockton, Whitman, Avon, Randolph and Holbrook.

The Taunton city council has given the Taunton Street Railway company permission to operate double tracks by electricity from Weir Bridge through Weir street, City square and Broadway to Bay street. This is to be an outlet from Taunton for three separate lines.

The New England Telephone & Telegraph company has purchased the Young Men's Institute at 7 Chardon street and is to tear it down and erect a new building to be used as its West End exchange.

The Fall River Electric Light company has petitioned the Legislature for permission to furnish electric power as well as light.

The contract for rebuilding the car house of the West End street railway at Everett, which was burned some months ago, has been let. The plans call for a building 283 feet long and 80 feet wide. There will be an addition of brick 105 feet long and 16 feet wide. This is to contain six fire-proof apartments. The building is to be ready for use in about two months.

A bill to incorporate the Malden, Melrose & Stoneham Street Railway company has been reported to the legislature. It provides that any power other than steam may be used.

An Atlanta, Ga., syndicate is negotiating with the Boston capitalists who own the road for the purchase of the Atlanta Consolidated Street Railway.

The Northampton Street Railway company has been granted a franchise to extend its tracks and put in electric power. The next day a majority of the stock was bought by men interested in the Springfield Street Railway company. These capitalists now own 60 miles of track in three adjoining Connecticut valley cities.

The owners of the Fairhaven & Westville Horse Railroad of Connecticut made $55,000 recently without turning a hand. A Boston syndicate, headed by A. C. Pond, president of the Winchester Avenue road of New Haven, Conn., paid this amount to horse railroad officials for an option to buy their road for $1,500,000. They were given until April 15th to raise the balance. Mr. Pond searched Boston, New York and Philadelphia in a vain effort to raise the money and consequently the capitalists are mourning the loss of their money while the horse railroad is that much in.

Five suits against the West End Street Railway company of Boston have been brought by passengers in an electric car which suddenly became ignited through a defective motor. The suits were for $5,000 each, but the jury awarded $250 to one man and smaller sums to the others.

The Clinton Street Railway company has been given permission to build 10 miles or more of electric road in that town, the main line to run from the Lancaster town line to the Berlin town line with branches to the trotting park, the Catholic cemetery and the South Clinton station of the Central Massachusetts railroad. The company is to allow any or all of the lines which ask for franchises to run over its rails by making satisfactory financial arrangements. The new line must be completed by November next. It is owned mainly by E. C. Swift of Chicago.

The Lynn & Boston Street Railway company now runs only electric cars between Chelsea and Boston, gaining 18 minutes on the old horse car schedule.

L. D. Dumouslin, who resigned recently as superintendent of the West End Street Railway department, has gone into the electrical underground conduit business.

The Edison Illuminating company is to put in a 360 light dynamo for an isolated plant for Fobes, Hayward & Co., candy manufacturers.

The Brockton & Stoughton Street Railway company has received a location between the two cities. Four and one

half miles of rails will be laid, work being begun at once.

The Worcester board of aldemen has granted a franchise to the Consolidated Street Railway company to double-track its line to the village of Quinsigamond on condition that it pave the street nearly the whole distance. On one street the company is compelled by the terms of its franchise to pave 18 inches each side of the track and macadamize the remainder of the street.

The New Hampshire Legislature has changed the name of the Laconia & Lake Village Horse Railroad company to the Laconia & Lakeport Street Railway company and authorized an increase of ca ital from $30,000 to $100,000.

The East Middlesex Street Railway company, with sixteen miles of track running from Woburn to Revere Beach has been purchased by the North Shore Traction company.

The Newton & Boston Street Railway company has decided to establish a power plant and furnish its own power for the operation of its line from Newtonville to Newton Upper Falls.

An electric road, for the benefit of summer tourists, is proposed from the village of Bethlehem, N. H., to the top of Mt. Agassiz.

The Brockton Street Railway company has leased the Holbrook & Brockton street railway for 99 years.

Boston capitalists have secured control of the Woonsocket street railway. They will make electric extension up the valley.

The assignee of the Germania Electric company reports that the liabilities exceed $100,000. The assets are figured at about $27,000. Of this amount $5,000 is for lamps on hand which would really be worth $25,000 were it not for the injunction which the Edison company has secured.

The Leominster & Fitchburg Street Railway company is to equip its lines with electricity this year.

The Rockland & North Abington Street Railway company has contracted for 10 Westinghouse car equipments and two 150 horse power generators.

J. C. E.

Northwestern Notations.

MINNEAPOLIS, May 13.—Joseph M. Green, Chamberlain, S. D., has sued the Western Union Telegraph company for $10,000. Mr. Green is chairman of the state Republican committee and he claims that last fall at the beginning of the campaign he made a contract with the company for a private wire into his private office, to be used by his operator. About three weeks before election the Democrats discovered that the private wire had been strung from the main wire outside the city. It was possible for an operator to hear in Green's office all messages received in or sent out of Chamberlain. The matter came to the attention of Superintendent McMichael of Minneapolis, who ordered the wire cut, and Green was compelled to get his messages through the offices. He brought suit against the company, claiming that during the last days of the campaign lack of wires seriously inconvenienced him in directing political work. The company sets up a general denial to the charge that it had a contract with him. The case was set for hearing last week, but was postponed to the fall term of court at plaintiff's request, and an effort will be made to avoid a trial.

It is believed that an ordinance has been framed that will solve the St. Paul street railway riddle. The board of alderman has passed it and the assembly is said to be ready to do so at the earliest opportunity. It is acceptable to the company, concessions having been made at several points. The new measure does not touch either the interurban transfers or the through line to Hazel Park. It simply calls for the immediate construction of a line to Lake Como, allows until June 1, 1894, for the completion of the Maria and Stryker avenue lines, and provides that no new lines shall be ordered until September 1, 1895. The change of the Seventh street cable to an electric line is not insisted upon, but Mr. Lowry will probably make the change.

Dow S. Smith, the new superintendent of the Twin City Rapid Transit company, has arrived in Minneapolis and assumed his duties at the central station. Since the promotion of Willard J. Heild to the general managership, the company has been without a superintendent.

Charles J. Glidden, secretary and treasurer of the Northwestern Telephone company, has been in Minneapolis and St. Paul, accompanied by J. W. C. Pickering and Charles E. Adams, directors of the company. They are on their semi-annual tour of inspection. Mr. Glidden says the telephone business is increasing very fast in the twin cities, last year being the most prosperous in the company's history. The Northwestern company will at once complete a new pole line to St. Paul, as the present one will not carry any more wires. It will also build lines from Shakopee to Mankato, Anoka to St. Cloud, and Hastings to Winona.

The city council at Marshfield, Wisconsin, has entered into a contract with the Marshfield Water, Electric Light & Power company for lighting the city for five years at the annual rental of $1,800 per year. The contract calls for 23 arc lights of 2,000 candle power.

The Columbian Electric company of St. Paul has filed a schedule of its assets and its liabilities, from which it appears that the former, including $15,323.56 book accounts, amount to $55,727.43, and the latter to $27,747.75. The Anchor Investment company, which holds notes to the amount of $11,000, is the heaviest creditor. The company has sued to recover $10,829.41 on four promissory notes.

There is a rumor that the Bryant avenue end of the Lyndale car line in Minneapolis is to be extended to the shores of Lake Harriet, but the officials of the company have not confirmed the report.

C. N. Parker of the Brainerd electric street car line has been elected president of the board of trade at Brainerd, Minn.

The Western Union Telegraph company has notified its employes in Minneapolis that hereafter all over-time put in by the operators will be computed at the rate of seven hours for a day's work.

The Minneapolis fire deparment is to be supplied with ten telegraph poles and 150 miles of wire.

The Northwestern Water & Light company of LeMars, Ia., has been organized; capital stock, $200,000. The officers of the company are: President, J. H. Whinchell; vice-president, Dr. M. W. Richey; secretary and treasurer, J. K. Alline. The new company will extend the facilities of the plant, and will also build, equip and operate electric light and water works plants at other places.

There has been incorporated at St. Cloud, Minn., the Water, Light & Power company, with a capital stock of $300,000. This includes the Water Works company, Water Power company and Electric Light company, and it is organized under the new act of the Legislature. The incorporators and officers are: President, H. M. Byllesby; secretary, J. A Chase; treasurer, N. O. Searle, and William Westerman. The limit of bonded indebtedness is $1,000,000, The dam will be raised three feet and other improvements made.

The partnership known as the Sneller Electric company has been dissolved. John W. Sneller withdraws. It is a Minneapolis firm.

The case of the Fargo Gas & Coke company against the Fargo Gas & Electric company was decided in favor of the plaintiff, the jury's verdict giving the plaintiff the full amount asked, $17,000. The latter company in March, 1889, purchased the plant of the former for $85,000. It refused to pay $13,000 on the ground of false representation, and was sued. The Gas & Electric company will appeal.

The Hartman General Electric company of Duluth will at once begin the extension of the incandescent line to Oneota, and will make other improvements.

City Engineer Cooper of West Superior, Wis., has furnished the common council an estimate for an electric light plant to be owned by the city. It is designed to supply an arc light circuit and its cost is estimated at about $100,000. Mr. Cooper says the cost of a complete system of arc lighting to cover the territory now covered, using 300 lights of 2,000 candle power each, will be $61,738. This contemplates twenty-eight miles of wire, 2,480 poles, 6 dynamos, of 60 horse power capacity each, a three hundred horse power compound engine, a brick building 50 by 100 feet, and one lot on water front. The full capacity of the plant would be 300 lights.

C. P. Wainman, Minneapolis, superintendent of the Northwestern Telephone Exchange company, has been at Sioux Falls, S. D., making arrangements for a complete remodelling of the telephone system of that city. About $5,000 will be spent.

G. A. Van Schriltz of Grand Forks, N. D., is contemplating putting in a telephone exchange at Crookston, Minn. He wants to construct a line from Crookston to Grand Forks.

Work has been commenced on an electric light plant at Chamberlain, S. D., for lighting the city.

It does not seem probable that Fargo and Moorhead will secure any street railway lines for the present. It is understood that the men represented by Mr. Bowman will not be able to secure from the councils of the two cities such franchises as they demand.

The case of Ilida Nelson against the Twin City Rapid Transit company is a peculiar one, and opens up a new idea in damage suits. It appears that the lady settled her claim some time ago with the company and signed a release of all claims against it. Afterwards she was not satisfied, and wanted to sue, and for the purpose of doing so claimed that she did not know how sick she was at the time of the settlement.

The St. Paul fire department has had considerable trouble with the Chandler fire alarm boxes, and agent E. B. Crandall, representing the company, has been sent on to see if he can rectify the difficulty. It is claimed that several bad fires could have been avoided had the alarm system done its work properly.

Murray Snell, for many years manager of the Western Union Telegraph company at Watertown, S. D., has been transferred to West Superior, Wis. He will be manager there.

The latest report from Deadwood, S. D., is to the effect that work will be begun soon on the proposed electric motor line from that city to Leadville.

The new car barn at Superior, Wis., will have accommodations for 13 double tracks. Offices for the superintendent and others will be provided in the building.

The electrical station for the Water, Light & Power company of Superior, Wis., will consist of two buildings, one for arc lighting and one for the incandescent system. Both buildings will be of brick and iron, and very complete in their equipments.

Egbert G. Handy, a St. Paul real estate man who failed this week, says that his trouble is due partly to the drain on his resources through his connection with the Columbia Electric company, which recently failed.

T. B. Walker and other capitalists interested in the proposed electric line from Minneapolis to Lake Minnetonka are said to be negotiating with J. J. Hill, of the Great Northern road, with a view to leasing his line to cover part of the distance.

N. L. P.

PERSONAL.

Elmer A. Sperry of the Sperry Electric Railway company is in Chicago. Mr. Sperry spends the greater part of his time at present in Cleveland, O.

NEW INCORPORATIONS.

Suffolk Gas company, Islip, N. Y; capital stock, $200,000; to manufacture and use gas and electricity for light, heat and power.

Huntington Electric Light, Heat & Power company, Huntington, N. Y.; capital stock, $20,000; to manufacture and use electricity.

American Electric Heating corporation, Portland, Me.; capital stock, $5,000,000; to manufacture and deal in all kinds of electric heating apparatus; Drummond & Drummond, Portland, Me.

Wallkill Valley Electric Light & Power company, Walden, N. Y.; capital stock, $16,000; manufacturing and using electricity.

Warrenton Electric company, Warrenton, Mo.; capital stock, $5,600; operating electric light plant; Peers & Morsey, Warrenton, Mo.

Texas Electric Burglar & Fire Alarm company, Corsicana, Tex.; capital stock, $30,000; to manufacture and sell electric burglar and fire alarms; D. L. Blackmon, Corsicana, Tex.

Spangler & Hastings Electric Railway company, Bellefonte, Pa.; capital stock, $42,000; constructing and operating an electric railway in Cambria county, Pa.; W. F. Reeder, Bellefonte, Pa.

Suburban Railway company of Philadelphia, Philadelphia, Pa.; constructing and operating an electric railway in Philadelphia, Pa.; William Jenks Fell, 131 South Fifth street, Philadelphia, Pa.

Philadelphia & Rosemont Passenger Railway company, Philadelphia, Pa; capital stock, $150,000; constructing and operating an electric railway in Philadelphia; Paul W. Smith, 411 Walnut street, Philadelphia, Pa.

Eureka Coal company, Seattle, Wash.; capital stock, $100,000; to own and operate coal and other mines, railroads, docks, wharves, electric light and power plants, etc; Preston, Albertson & Donworth, Seattle, Wash.

Chicago Electric Transit company, Chicago, Ill.; capital stock, $150,000; to locate, lease and operate street railroads with such power as necessary; Willits, Robbins & Case, 318 Home Insurance building, Chicago, Ill.

East End & Sharpsburg Electric Railway company, Pittsburg, Pa.; capital stock, $300,000; constructing and operating an electric railway in Pittsburg, Pa.; Edward Fell Lukings, 812 Girard building, Philadelphia, Pa.

Electric Traction company of Philadelphia, 2501 Kensington avenue, Philadelphia, Pa.; capital stock, $50,000; supplying motor power to passenger railways, etc.; William Henry Lex, 51 North Sixth street, Philadelphia, Pa.

Manchester Electric Truck company, Manchester, N. H.; capital stock, $600,000; to manufacture and sell trucks, wheels, motors, engines, machinery, cars, tools, and electrical appliances; David Cross, Manchester, N. H.

Pricesburg Electric Light company, Dickson City, Pa.; capital stock, $20,000; supplying light, heat and power by means of electricity, etc., to persons, partnerships, and associations residing in or adjacent to Dickson City,

Lackawanna county, Pa.; Patterson & Wilcox, Library building, Scranton, Pa.

Signal Alarm company, New Orleans, La.; capital stock, $10,000; to do general dealing in patent rights and to manufacture and vend electrical appliances under the Hall-Lillard patents; Isaac Kinsey, New Orleans, La.

Clay City Manufacturing company, Clay City, Ind.; capital stock, $25,000; to manufacture and sell cooperage material, purchase or lease timber lands and timber, and to do electric lighting and generate power; B. M. Gnirl, Clay City, Ind.

Grand Island Rapid Transit, Light & Power company, Grand Island, Neb.; capital stock, $250,000; to construct and operate a street railway by electricity, horses, mules or cable, and to furnish power in the streets of the city of Grand Island, Neb.

Bliss Engineering company (incorporated in West Virginia), Washington, D. C.; capital stock, $500,000; buying, selling, contracting and operating electric supplies, plants, etc., for railways, lighting, etc.; Needham & Cotton, 14-15 Sun building, Washington, D. C.

United Electric Light & Power company, Bayonne, N. J.; capital stock, $50,000; to construct, maintain and operate works for the supply and distribution of electricity for electric light, heat and power, etc.; VanBuskirk & Parker, Fuller building, Jersey City and Bayonne, N.J.

Equitable Dynamo company, Chicago, Ill.; capital stock, $100,000; to manufacture and deal in electrical machinery, appliances, etc., to erect and operate plants for generating and supplying electric light, heat and power; Reed & Brown, Home Insurance building, Chicago, Ill.

Pine Bluff Water, Gas & Electric Light company (incorporated in West Virginia), New York, N. Y.; capital stock, $500,000; purchasing and constructing water works, gas works and electric light plants in Pine Bluff, etc.; Hobbs & Gifford, 58 William street, New York, N. Y.

ELECTRIC LIGHTING.

The Salisbury, Md., electric light plant was destroyed by fire recently. The loss is $16,000.

James H. Garrett of Anaconda, Mont., proposes to erect an electric light plant at Bonner's Ferry, Idaho.

The Electric Light company of Springfield, Mass., contemplates building a $125,000 power station at Indian Orchard.

The city council of Medford, Mass., has authorized the mayor to petition the Legislature for a special act to construct and operate an electric light plant.

The electric light plant at La Junta, Colo., was destroyed on the evening of May 10th. It is stated that an explosion took place and blew up the building leaving it a total wreck, killing one man and seriously injuring others. The plant was owned by McComb & Brannon of Denver, was valued at $20,000 and is a total loss.

ELECTRIC RAILWAYS.

A survey is being made for the building of an electric railroad between Carlisle, Ky., and Sharpesburg.

It is stated that the Chicago & North Shore electric street railroad will be opened for operation June 11th.

The street railway company of Escanaba, Mich., will build several extensions to its lines the coming summer.

Double-decked storage battery cars have been operating in Paris from La Madelaine to St. Denis for more than a month, and are said to be giving satisfaction.

It is stated that the extension of the electric line from Pikesville to Arlington, Md., will be completed by June 1st. The extension will consist of seven miles of track.

The Detroit Suburban Railroad company, Detroit, Mich., has been granted a franchise by the village of Grosse Point to extend its line to the eastern limit of that village.

The Globe Street Railway company, of Fall River, Mass., has completed the work of changing its motive force to electricity. The company has about 24 miles of track and one of the finest plants in the country.

The elevated portion of the Lake Roland electric railroad was tested on May 2d, by running a motor over it to the center of the city. The Roland Park division of the line will be in operation to the down town terminus in a few days.

The Buda-Pesth Tramway company, Austria, which has been operating its lines by horse power, has been amalgamated with the electrical town undertaking. If this agreement is carried out Buda-Pesth will have an electric tramway system on a gigantic scale.

The General Electric company has just completed an electric locomotive for the Crescent Beach branch of the Boston & Maine road, and it is stated that the locomotive will be employed regularly to haul goods and passenger carriages over the branch mentioned.

The Third Street Railway company, Dayton, O., is experimenting with a storage battery car, which, it is said, is proving satisfactory. The total number of miles of street railroads contemplated in Dayton by recent ordinances is about 50, or double the present street railway mileage in the city.

The Southwest Missouri Electric company, which is building an electric line connecting Carterville and Webb City with Joplin, Mo., is considering plans to extend the line to Carthage and to Galena, Baxter Springs and Kansas City. Baxter Springs offers a right of way and water power free. The road, if constructed, will be 40 miles long.

The East Side Railway company, Portland, Ore., has opened its standard gauge electric line, fifteen miles in length, from East Portland to Oregon City. The Portland General Electric company supplies current from its Oregon City station to Milwaukee, or about half of the distance. The remainder of the line is operated from the East Side station in Portland. An hourly service is given.

The work of building the electric railroad from Mayfield, Cal., to the Stanford University will begin shortly. It is said that the storage battery system is to be tried on this line. The name of the corporation is the Mayfield & Stanford University Electric railroad. The route is from the Southern Pacific depot at Mayfield up Lincoln street to Yale street in College Terrace; thence, through Palo Alto avenue to Bowdoin street; thence, to Mayfield thoroughfare, to a point opposite the quadrangle of the class rooms. This is as near as Senator Stanford will permit any company to approach the university. He has announced his purpose to lay a track from the quadrangle to the Mayfield thoroughfare, a distance of about a quarter of a mile. The company will be permitted to run its cars over this track to the quadrangle. The new electric road is built for the accommodation of students who reside in Mayfield and College Terrace, and for those who desire to reach the former point to take the cars either for San Jose or San Francisco.

POWER TRANSMISSION.

The General Electric company of New York, through the Grand Rapids Electric company, has closed a contract with the Western Michigan Electric company for the electrical apparatus to be used in the transmission of electrical power from Lowell.

At the last meeting of the Lynn board of aldermen the Thomson-Houston company asked permission to lay wires underground from its present works on Center and Federal streets to the river works. This is for the purpose of transmitting power from the power house, which will be located on the marsh, to the Center and Federal street works. These works will be run with the power generated at the power house.

LEGAL DECISIONS.

A message filed with a telegraph company at a city in Texas, addressed to the sender's agent in California read as follows: "Close the trade. I will come soon." On his arrival the sender discovered that the message had not been delivered, and that the deal had failed, thus requiring him to return to Texas. The court held that his expenses to and from California were proper items of damages against the telegraph company, but losses resulting from the sale of his property at a sacrifice before starting were not. The telegraph company having received full pay for transmission of the message to its destination, without any contract limiting its liability to its own line, was bound to deliver the message to the sender's agent, even though it had to be sent part of the way over the line or another company. The sender's testimony showed that the message was not written on a blank contract of the telegraph company, and that, when he returned from California, he examined the original copy, which was not then attached to one of such blanks. The company's agent testified that when he received the message he immediately attached it to a blank contract form, and that he was not authorized to receive or send a message unless on such blank. The testimony justified the court in finding that the message was not attached to a blank contract form when received by the agent.

Two telegraph companies made a written agreement whereby one was to build and equip certain lines and connect them with those of the other. The second was to issue and deliver to the first its bonds secured by a mortgage on all its property, including the lines contracted for. On the next day, this second company agreed with the stockholders of the first to exchange those first company bonds for first company stock in equal amounts. The bonds were issued and exchanged as agreed, the second company thereby getting control of the first, electing its own officers to the offices of the first, and managing the two companies as one concern. The new lines were built in part by the second company, as contracted, and connected with the system of the first company, the second raising the money therefor by issuing its own bonds secured by a mortgage covering after-acquired property. This mortgage was not recorded until after the recording of the mortgage by the first company. In the agreements and the acts done in pursuance thereof, there was nothing contrary to law or good morals. The act connecting the new lines with those of the first company, and their use as a part of the first company's system, was a sufficient delivery of them under the contract, and the new lines then became subject to the first company's mortgage, and the lien thereof took precedence of the second company's mortgage. A foreclosure sale of the new lines under the second company's mortgage, or the sale of part thereof under a judgment, would not affect the rights of the first company's mortgagees, they not having been parties to either suit. United Lines Telephone company vs. Boston Safe Deposit & Trust company, 13 Sup. Ct. Rep. 396, Jan. 30, 1893.

MISCELLANEOUS.

Fire destroyed electrical machinery of the Union Electric company, New York, last month to the amount of $5,000

It is rumored that the Canadian General Electric company is contemplating purchasing the Royal Electric company of Montreal and the Ball Electric company of Toronto. By buying out the former company, the Canadian General Electric company secures the Thomson-Houston patents for Canada on arc lighting.

The power house, car house, and cars of the Grand View Beach railroad, running between Charlotte and Manitou, two pleasure resorts near Rochester, N. Y., were destroyed by fire last week. The loss is estimated at $60,000 in addition to this summer's traffic, as the road cannot be equipped for several months.

The Western Electric company of Chicago has a base ball team of which it is proud. On Saturday of last week the nine played with an aggregation known as the Coals, defeating it after an interesting contest by a score of 9 to 6. The game was played at Washington Park, and the batteries were: Western Electric, Smith and Hunstock; Coals, Murray and Wink.

George Westinghouse, jr., has applied to the United States Circuit Court in New York for an injunction against the General Electric company, to prevent it from using in the manufacture of converters a device which he claims to have invented and patented. He also asks for an accounting of the profits made by the General Electric company while using this device.

The Westinghouse Electric & Manufacturing company has received a contract from the Philadelphia Traction company for 600 motors and 8,500 horse power in generators. It also has the contract to supply all the electrical apparatus to be used on the line in that city. It is claimed that this is the largest contract that has ever been let to any electric company for street railway apparatus.

W. M. Stine, who has taken charge of the department of electricity and electrical engineering at the Armour Institute, Chicago, announces that this department is being equipped for technical work of the highest grade. Its aim is to do work which differs from other technical schools in this respect. While laying full stress on theoretical training, it intends to combine as much of the practical as circumstances and time will permit.

The Concord Land & Water Power company, Concord, N. H., has purchased from the Gas & Electric Light company all its electric apparatus, franchises, poles and lines. It will also utilize the water power at Garvin's Falls in the Merrimac River. This gives the Land & Water Power company the entire control of the electrical interests in the city and removes its chief competitor. It has now about 10,000 horse power available for electrical and manufacturing purposes.

TRADE NEWS.

D. W. Davis, western manager of the Phœnix Iron Works company, has recently moved into more commodious quarters at 519 Rookery, Chicago.

The New York Insulated Wire company, New York, has issued its World's Fair edition of its catalogue and price lists. The book is compiled in a neat manner, and is fully descriptive of this company's assortment of wires and tubing.

The Redding Electric company of Boston, Mass., has removed its offices to 336 Congress street, where it will have increased facilities for handling its growing business. This company's catalogue of Iona specialties is a comprehensive book and will well repay perusal.

W. R. Brixey, manufacturer of Day's Kerite wires and cables, New York, has taken the contract to manufacture and lay for the Metropolitan Telephone & Telegraph company two No. 18 conductor submarine cables, similar to the nine in service at the present time between New York and Jersey City, under the North River.

I. L. Faucett, Quincy, Ill., has issued a neat little advertising hand-book called "Scraps for Engineers," the object of which is to place engineers, firemen, etc., in correspondence with leading representative houses in the country in mill supplies, steam engines, boilers, pumps and other mechanical devices. It contains several concise tables of valuable information of interest to engineers.

The Ball Engine company, of Erie, Pa., has received orders during the past week for one 100 horse power cross compound engine from the Compania Mexicana Del Gas y Luz Electrica; three 100 horse power tandem compound condensing engines from the Fond-du Lac Light, Power & Railroad company, and one 130 horse power engine from the International Electric company, Salt Lake City, Utah.

The Hanson Battery & Power company, of Washington, D. C., after two years of practical contact with the lines of electrical trade, is now making what it claims to be one of the best batteries on the market. A large number of installations have been made in the East and West for power to run launches, lighting plants, pumps, etc., and none but the most satisfactory reports have been received from them.

The Electric Appliance company is supplying its customers and the general trade with a complete catalogue of the Meston motor, showing its various adaptations for ventilating, dental, sewing machine and light power work. The Emerson company is a pioneer in this field of electrical work, and as this is the first catalogue of the kind ever published, it makes very interesting reading, and contains valuable information for central stations supplying alternating currents.

Cummings & Engelman is the style of a firm which has recently been organized in Detroit for the purpose of doing electrical construction work, succeeding Cummings & McCoy. The firm is composed of two capable and energetic young men and proposes to get its share of the

business in the West by good workmanship, moderate prices and careful personal supervision. Especial attention will be paid to underground work and the transmission of power. Mr. Cummings' conduit for underground conductors will also be exploited. The office of the firm is at 25 Cleland building, Detroit, Mich.

The Ansonia Electric company, Chicago, is having excellent results with its new street railway appliances for overhead construction. The new material is guaranteed both for strength and insulation, and has received the indorsement of railway experts. The Ansonia Electric company has added to its list of contracts for overhead equipment the road thirteen miles in length, running between Goshen and Elkhart, Ind. This company has also recently secured a thirty ton order for its P. & B. line wire.

Diehl & Co. of New York are sending to the trade neat little pocket pamphlets, with illustrated description of their type of motor, with price list, etc. This motor is used in connection with the exhaust disc wheel combination. Another pamphlet is an illustrated catalogue of the Diehl electric fans. The special feature of these fans is that no shafting or belting is required. Each fan contains its own motor, wound for 110 volts or under, continuous incandescent, or for any number of amperes continuous arc circuit. It can also be effectively operated in series on a 220 volt or 500 volt street railway current.

Taylor, Goodhue & Ames have received the best proof that their moving from 827 Monadnock block to 348 Dearborn street, Chicago, was a wise step, by the increased number of orders that they are receiving from city customers. The demand for the Wagner direct current fan motor continues very large, and it is reported that these motors are giving the best of satisfaction. The demand for alternating motors, both for power and fan work, continues to be very satisfactory. Taylor, Goodhue & Ames keep a large stock of these motors continually on hand so that any unnecessary delay in shipping and consequent annoyance to the purchaser is avoided.

The Ansonia Electric company, Chicago, is calling particular attention at this season, preparatory to the approaching warm weather, to its stock of Edison fan motors run by the Edison-Lalande battery. The company's stock of fan motors is very extensive, consisting mostly of seven and nine inch outfits. The seven inch outfit is complete, with chemicals sufficient to run the motor for 70 hours continuously, and the nine inch outfit to run the motor for 100 hours continuously. In addition to the fan motors, the Ansonia company is well stocked with the Diamond carbon battery. This battery is a favorite among physicians, and the many testimonials received by the company endorsing its merits are a source of much gratification.

The several new buildings of the Page Belting company, Concord, N. H., which have been in process of construction for some time past, are now completed. The largest of the buildings, the belt shop, is three stories high and 264 by 58 feet. It is fully equipped with new and special machinery for the manufacture of belts. Electricity is the company's principal motive power, and it possesses an extensive system of electric lighting in its buildings and on its grounds. A monster belt was recently completed by the company for exhibition at the World's Fair. It is 102 inches in width and more than 200 feet long, and is probably the largest belt in the world. Two other large belts have been turned out, one 72 inches and the other 73 inches in width, and they are intended to drive Westinghouse dynamos for lighting the buildings at the fair.

BUSINESS.

The Conover Manufacturing company of New York is now located at 39-41 Cortlandt street.

The Peckham Motor Truck & Wheel company of New York has moved from 45 Broadway to the Havemeyer building.

Manager W. C. Brown of the New York office of the Wainwright Manufacturing company of Boston will hereafter be found at 68 Cortlandt street.

The Backus Water Motor company, Newark, N. J., has changed its name, and all communications to this company should be hereafter addressed to the Backus Manufacturing company.

The Ansonia Electric company, formerly the Electrical Supply company, Chicago, recently closed another contract in Iowa for Helios arc lamps, to be used in street and commercial lighting.

W. R. Ostrander & Co., manufacturers of speaking tube and electric bell supplies, 197 Fulton street, New York, have moved to 201 Fulton street, where they have increased facilities for carrying on their growing business.

Sixteen carloads of material for the new boiler plant of the North Shore Traction company have arrived at the power station in Salem, Mass., and the work of erection will be pushed forward rapidly. The boilers are of the National water tube type, manufactured by the National Water Tube Boiler company, of New Brunswick, N. J., and are representatives of the most advanced practice in modern boiler construction.

Taylor, Goodhue & Ames expect that much interest will be created among World's Fair visitors by the exhibit of their alternating current power motors. Two of these will be installed in their exhibit in electricity building; one two horse power coupled direct to an exhaust fan, and one ten horse power which will operate a direct current generator. These motors are single phase, no special circuit being required for their operation.

The firm of H. Ward Leonard & Co., New York, has met with success in its peculiar line of bulk electric contracting which is most satisfactory. The business of the company amounted to $530,000 during the first year, and its business is increasing rapidly, both in New York and throughout the country. Since the first of January the capital of the company has been doubled, the fully paid capital now being $120,000.

J. G. Brill & Co., Philadelphia, manufacturers of electrical cars and car equipments, claim to be the only firm in the country which equips cars electrically in every particular prior to shipment. All cars and trucks built by the Brill company and equipped before shipment are tested on the company's private track, one-third of a mile in length, including sharp curves and heavy grades, insuring accuracy in the electrical work as well as certainty of operation when the cars reach destination.

The Phœnix Iron Works company, manufacturer of automatic engines, boilers, heaters, etc., Meadville, Pa., reports constantly increasing sales. Both engine and boiler departments are crowded and working overtime. Additions to the works are contemplated to take care of increasing business. Among some of the more important recent sales may be mentioned eight horizontal tubular boilers, 1,200 horse power, for the Allentown, Pa., Street Railway company, two 300 horse power condensing compound engines for the Saginaw, Mich., Power company, and numerous others.

The Chicago readers of the WESTERN ELECTRICIAN will be pleased to learn that Frank S. Bishop, Chicago representative of the Illinois Central railway, has been promoted to the position of superintendent of ticket agents for his company. Mr. Bishop will have charge of the Chicago terminal district, with his office at 58 Michigan avenue. Mr. Bishop, it will be remembered, is the gentleman who, in company with Jesse Scribner, of the western department of the General Electric company, made such a success of the St. Louis convention train. Mr. Bishop on this trip made many friends for his road among the convention delegates, who will be glad to learn of his promotion.

Word has just been received from Alfred C. Einstein, president and treasurer of the Consolidated Engineering company, Security building, St. Louis, that his company has just succeeded in securing in Nashville, Ill., a contract for a 40 light arc and 650 light incandescent plant, together with an Ideal engine and steam plant. The contract in Nashville includes the building and, in fact, the entire construction of the plant throughout. The Consolidated Engineering company has opened an electrical supply house and will carry a full line of everything in electrical goods, from the smallest screw to the largest dynamo. The officers of this company are well known in the electrical business as energetic men, and it is safe to predict that they will make a success of this new branch of their business.

ELECTRICAL PATENTS.

Issued May 9, 1893.

496,859. Transfer System for Telephone Switchboards. Emery A. Clark, Sioux City, Ia.

496,863. Apparatus for Electrolysis of Salt. Thomas Craney, Bay City, Mich.

496,864. Electrolytic Apparatus. Thomas Craney, Bay City, Mich.

496,865. Electrolytic Apparatus. Thomas Craney, Bay City, Mich.

496,871. Electric Meter. Oscar Ericsson, Sioux Falls, S. D.

496,878. Galvanic Battery. Charles W. Holtzer, Brookline, Mass.

496,882. Electric Arc Lamp. Martin Kruegar, Chicago, Ill.

496,890. Method for Welding Metal. Arthur J. Moxham, Johnstown, Pa.

The method is more particularly designed for welding pieces having varying widths throughout the cross-section. The ends of the pieces are cut away at points where the width is greatest, so that the thinner parts will come in contact, transmit the welding current and become welded before the thicker parts come in contact. By this means a weld of equal strength throughout the entire cross section is obtained.

496,896. Contact for Underground Electric Railways. William O. Prewitt, Lexington, Ky.

496,901. Switchboard for Electric Circuits. Albert L. Rohrer, Lynn, Mass.

496,904. Multiple Switchboard Apparatus. Charles E. Scribner, Chicago, Ill.

The apparatus is designed for metallic circuits, and the subscriber's generator, when operated, is brought automatically into a circuit formed by grounding the open limb of the metallic circuit at the subscriber's station, the limb thus grounded being connected through the subscriber's annunciator and battery to ground at the central office, the other limb of the metallic circuit being normally open at the central office and being connected with the test pieces of the switches of the line, and being branched to a normally open contact spring of a grounding switch. The subscriber's generator, when not in use, is shunted to remove its resistance from the circuit. A combined calling, listening and grounding switch is provided of such construction that when the plug is lifted the operator's telephone and the individual annunciator are bridged across the strands of the cord of the loop plug.

496,905. Multiple Switchboard System. Charles E. Scribner, Chicago, Ill.

The subscriber's bell is placed in a normally closed ground branch, and the subscriber's generator and telephone are so arranged that when the telephone is on the switch the telephone will be shunted and the generator included in the circuit, while, on removing the telephone from the switch the generator will be shunted and the telephone brought into circuit, the ground branch through the bell being opened also by the removal of the telephone.

496,906. Multiple Switchboard Testing Apparatus. Charles E. Scribner, Chicago, Ill.

496,907. Testing Aparatus for Multiple Switchboard Systems. Charles E. Scribner, Chicago, Ill.

The telephone lines are connected through the metallic circuit with the different switchboards the limb of each circuit which connects with the springs and test pieces being normally grounded through the subscriber's bell when the telephone is hung up, while the other limb is normally open at the subscriber's station. The limb which is grounded is permanently connected through the high resistance individual annunciator of the line at the central office. The connections are such that when the terminal plug of one line is inserted in the spring jack switch of another line the opposite corresponding limbs of the two circuits will be reciprocally connected together; that is, that limb of the circuit connected with the sleeve of the plug will be connected with the test portion of the other line, while the test portion of the first line, which is connected with the tip of the plug, will be connected with the limb of the other line which extends to the spring of the switch in which the plug has been inserted.

496,918. Safety Connection for Induction Coil Systems. Elihu Thomson, Lynn, Mass.

The invention is designed to prevent accident caused by coming in contact with an electric circuit normally of low tension, when the latter shall have accidentally come in contact with a high tension circuit which is grounded at some point. A device is included in a grounded circuit from a low tension line which is adapted to be actuated when said high tension current shall reach said line to open up a connection to ground of low resistance, and thereby shunt the body of the person in connection with the low tension line.

496,945. Electric Traveling Crane. William H. Morgan, Alliance, O.

496,959. Apparatus for Utilizing Solar Heat. Melvin L. Severy, Boston, Mass.

496,962. Dynamometer. Joseph A. Wade and John Cherry, Hornsea, Eng.

496,963. Dynamometer. Joseph A. Wade and John Cherry, Hornsea, Eng.

497,001. Method of Making Conductors for Armatures. Rookes E. B. Crompton, Chelmsford, Eng.

497,014. Process of Separating Precious Metals From Ores. Frederick W. Cleghorn, Salt Lake City, Utah.

497,023. Means for Displaying Advertisements. Edward O. Hart, Chicago, Ill.

497,024. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

The trolley makes contact with a series of sectional conductors, each section being connected by a branch with the supply conductor. In the branch is included an electro-magnetic device of high resistance, but so adjusted that the strength of the current passing through the same when the trolley arrives upon any section, will be sufficient to attract an armature which closes a short circuit between the section upon which the trolley has reached and the supply conductor.

497,025. Overhead Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

497,038. Electric Lamp. John Waring, Manchester, Conn.

An incandescent lamp is filled with a gas composed wholly or largely of elements of high atomic weight, as bromine, the bulb of the lamp being hermetically sealed to retain the bromine. The inventor claims that, by thus using a gas of high atomic weight, air washing of the carbon is prevented.

497,061. Electric Railway Switch. Edward F. Stone, Hyde Park, Mass.

497,062. Shoplifting Detector. Fred Sturtevant, Charlestown, Mass.

497,104. Automatic Switch for Mast-arms. William A. Turbayne, Detroit, Mich.

497,110. Multiphase Electric Motor. Paul A. N. Winand and Carl O. C. Billberg, Philadelphia, Pa.

The invention consists in winding the coils of the armature, which are supplied with alternating currents of different phases, so that the coils overlap each other, and this in such a manner that each coil has a magnetic effect on the core greatest at the center of the coil and diminishing towards the opposite ends of the coil, where it laps or is overlapped by the other coils.

497,111. Grain Binding Machine. William Bayley, Springfield, O.

497,113. Transformer Motor. Otto T. Blathy, Buda-Pesth, Austria-Hungary.

The motor comprises two magnetic fields lying in parallel planes and preferably at right angles to each other. The fields are excited by coils supplied with alternating currents of phases differing by 90 per cent. A single armature is provided whose coils extend into both fields. Since the magnetic fields are at right angles the maximum strength of the one will occur at the time of the minimum strength of the other, and the currents thus induced in the coils of the armature cause the latter to rotate.

497,117. Magnetic Ore Separator. Charles G. Buchanan, New York, N. Y.

497,120. Electrical Circuit. Charles E. Chinnock, Brooklyn, N. Y.

497,123. Commutator for Electric Generators or Motors. Midbury W. Hassan, Rochester, N. Y.

497,129. Electro-plating Apparatus. Albert R. Reams, Elmira, Cal.

497,144. Pedal Switch for Electric Motors. Levi Teal, Philadelphia, Pa.

497,197. Portable Electric Abrading Device. Aaron J. Nellis, Pittsburg, Pa.

497,200 Electric Lamp Support. James Nortney and Frank Schefold, New Albany, Ind.

497,203. Electric Time Stock Feeder. Herbert S. Page, Medford, and Livy Spear, Boston, Mass.

497,251. Coupling for Electric Light and Gas Fixtures. George Peeples, Philadelphia, Pa.

497,263. Electric Cigar Lighter. William P. Carstarphen, jr., Denver, Colo.

497,281. Signal Transmitting Apparatus. Morris Martin, Malden, Mass.

497,293. Trolley Wire Support. Henry A. Hamlin, Minneapolis, Minn.

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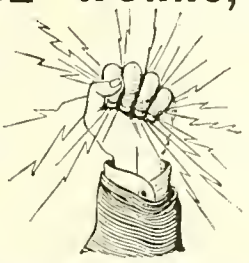

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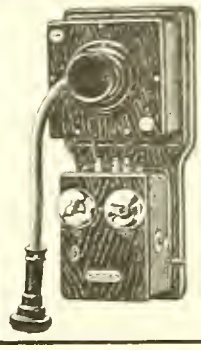

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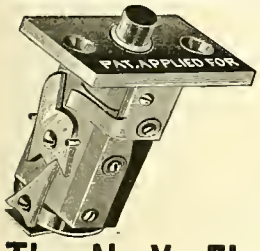

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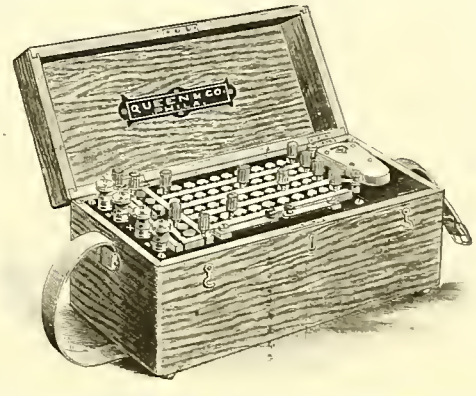

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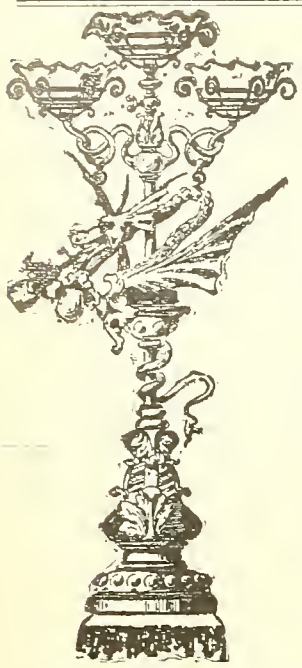

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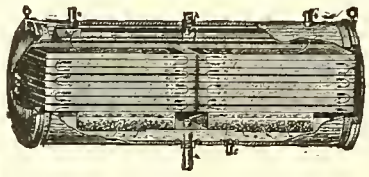

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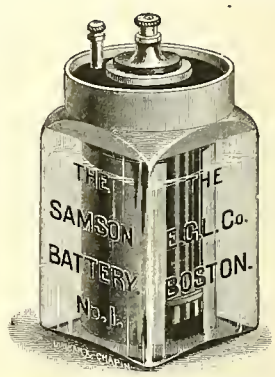

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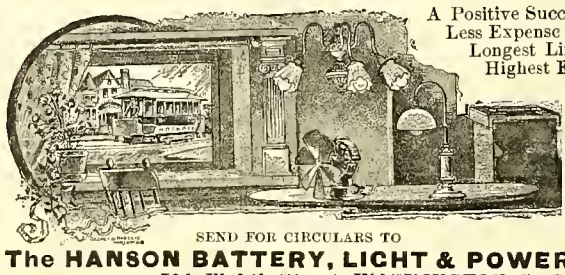

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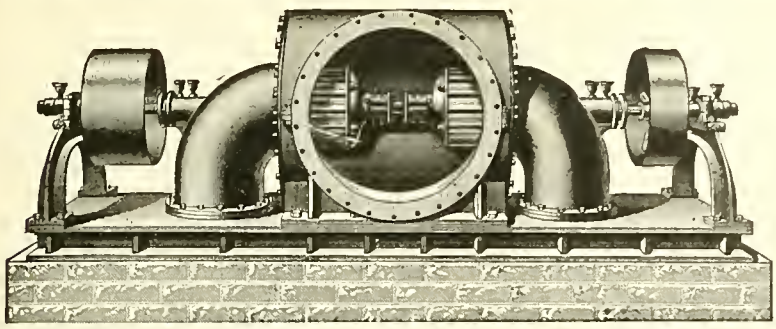

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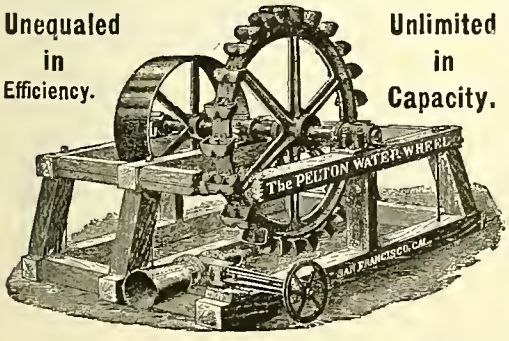

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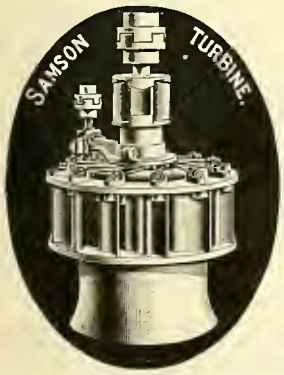

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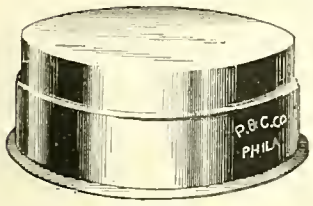

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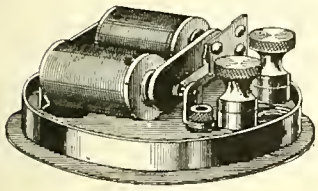

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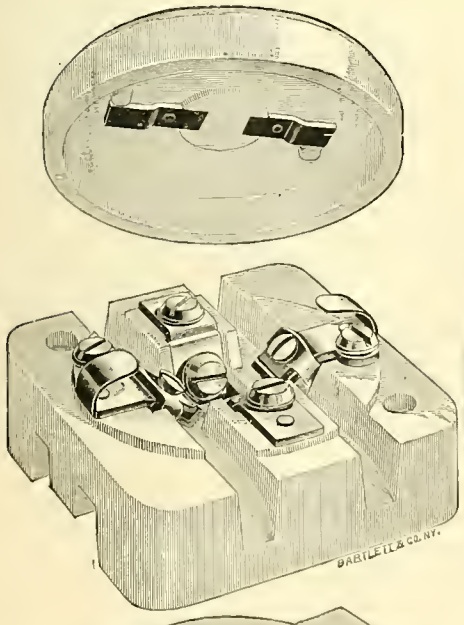

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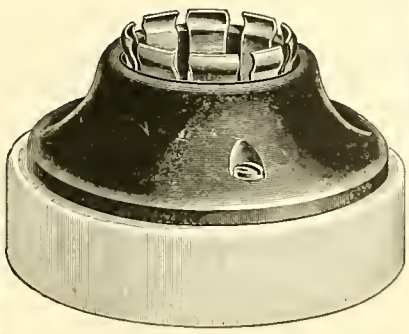

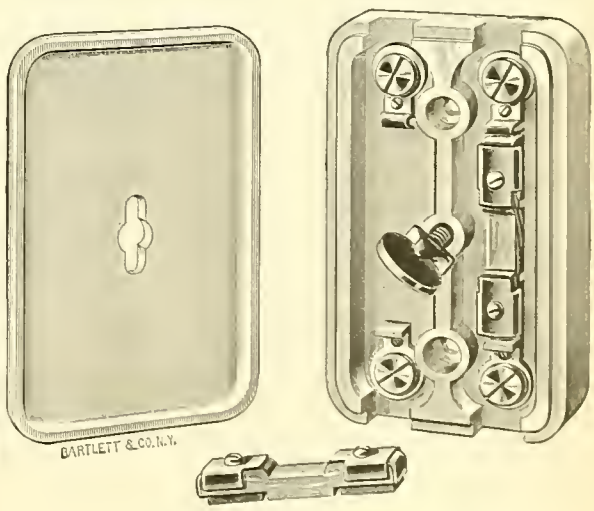

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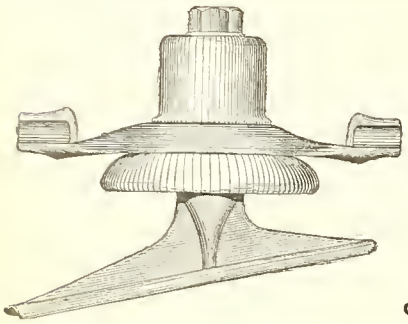

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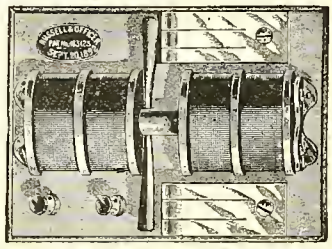

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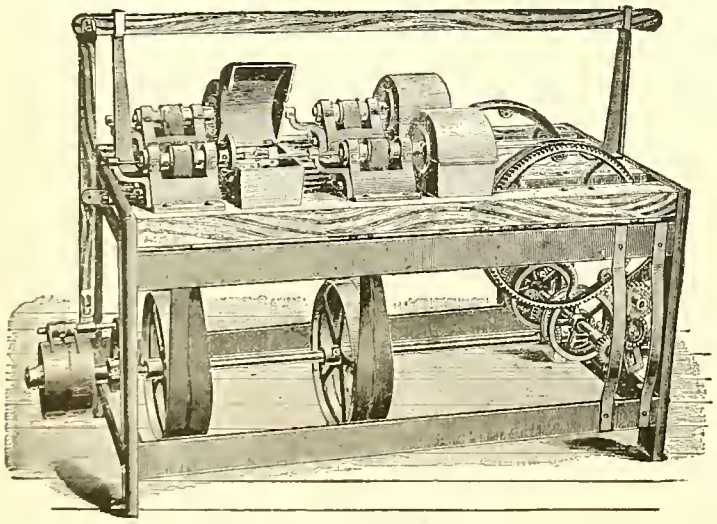

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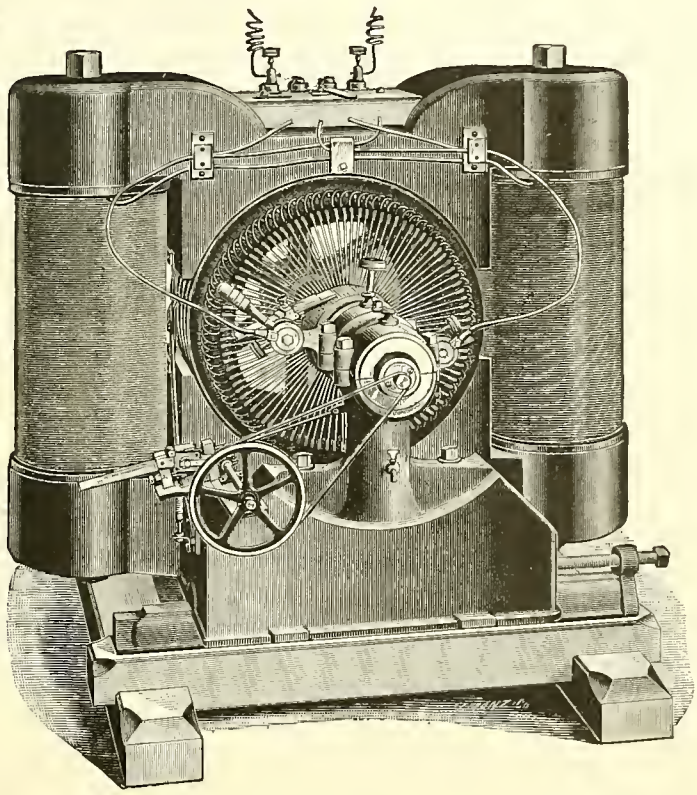
BUILDERS OF THE STANDARD SYSTEM OF ARC LIGHTING.

FOR FURTHER INFORMATION



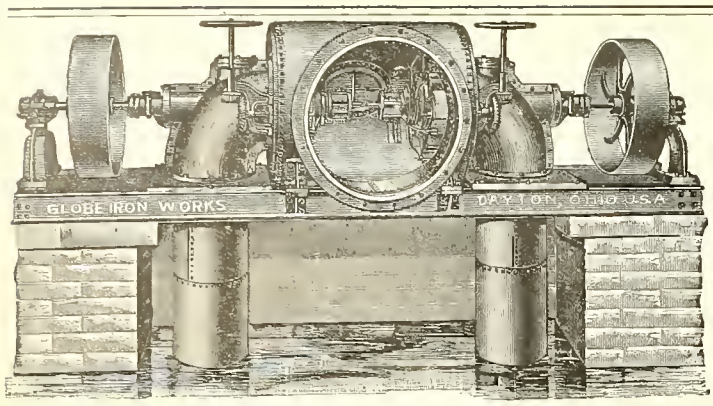
ADDRESS THE GENERAL OFFICES.

NOTICE.

Central Station Managers, Municipal Officers, Owners of Isolated Lighting Plants and Prospective Purchasers everywhere are invited to inspect and investigate the **STANDARD SYSTEM** before contracting for apparatus.

For lighting stores, foundries, factories or the streets of a city, this system has no equal.

Our contract does not obligate the purchaser to buy apparatus or supplies exclusively of us for a term of years, but courts open competition and encourages fair tests for merit between any and all existing arc lighting systems and the STANDARD.



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TURBINE WATER WHEEL.

PARTICULARLY ADAPTED TO DRIVING

Electric Light and Power Stations

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

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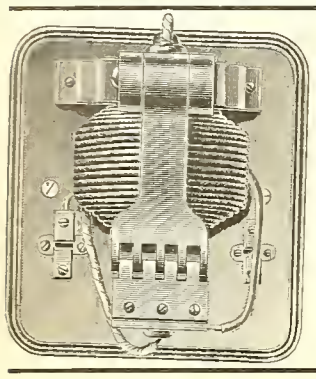
SUCCESSORS TO STOUT, MILLS & TEMPLE. **DAYTON, OHIO.**



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Automatic Lightning Arrester

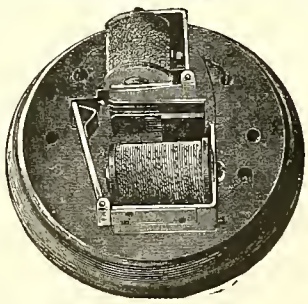
Will take care of any number of discharges of lightning per minute. They will prevent damage from lightning on any circuit not using the ground for return. They are intended only for station use and for the protection of generators and motors. They have no equal. They automatically rupture the arc formed by the lightning, and never short-circuit, thereby grounding the line. Price, $15.00 per set of two and any one purchasing a set will be allowed to return them and have their money refunded provided they do not absolutely protect all circuits to which they are attached

KESTER ELECTRIC CO.,

DYNAMOS, MOTORS AND POWER GENERATORS,

TERRE HAUTE, IND.

THE SECHRIST AUTOMATIC SWITCH



For controlling Incandescent Lights in private residences by using automatic gas keys and an ordinary battery or shunt circuit.

WANTED:—One good construction firm in each city to represent us.

Apply to

ALBERT SECHRIST,

Manufacturer and Patentee, DENVER, COLO.

SALES OF WESTINGHOUSE ENGINES,
MARCH AND APRIL, 1893.

COMPOUND.

			H.P.
E. D. Leavitt (for Calumet and Hecla Mines),	14th order,	Cambridgeport, Mass.,	600
E. D. Leavitt (for Calumet and Hecla Mines),	15th "	" " "	600
Brooklyn City and Newtown Railway (K),	7th "	Brooklyn, L. I.,	330
Manufacturers' Electric Co.,		Philadelphia, Pa.	330
McMullen & Morris,		West Superior, Wis.,	330
Warner's Portland Cement Co.,	1st "	Syracuse, N. Y.,	330
Camden, Gloucester and Woodbury Railway (K),	1st "	Gloucester, N. J.,	330
Camden, Gloucester and Woodbury Railway (K),	2d "	" "	330
Camden, Gloucester and Woodbury Railway (K),	3d "	" "	330
Newton and Boston Railway,	1st "	Newtonville, Mass.,	260
Riverside Park Railway Co.,	3d "	Sioux City, Ia.,	260
Detroit Citizens' St. Railway Co.,	5th "	Detroit, Mich.,	260
" " " "	6th "	" "	260
Westinghouse Electric and Manufacturing Co. (K),	38th "	Pittsburg, Pa.,	260
Olean Street Railway;		Olean, N. Y.,	200
Newton and Boston Railway,	2d "	Newtonville, Mass.,	160
Warner's Portland Cement Co.,	2d order,	Syracuse, N. Y.,	160
Marion Electric Light and Power Co. (for railway),		Marion, Ohio,	160
Name withheld temporarily,	22d "		160
" " "	23d "		160
" " "	24th "		160
" " "			160
Brigantine Transit Co. (for railway),		Brigantine, N. J.	130
Chandler & Price,	2d "	Cleveland, Ohio.	100
Germania Mills		Holyoke, Mass.,	100
Fuel Gas and Mfg Co.,	4th "	Pittsburgh, Pa.,	100
Maryland Steel Co.,	13th "	Baltimore, Md.,	100
Ohio Steel Co.,		Youngstown, Ohio,	85
Unknown,	1st "	Barcelona, Spain.	85
"	2d "	" "	85
"	3d "	" "	85
Westinghouse Air Brake Co.,		Hanover, Germany,	65
Rosal Hermanos		Berga, Spain,	65
Elmira Knitting Mills,		Elmira, N. Y	65
Nichols Chemical Co. (K),	10th "	Laurel Hill, N. Y.,	65

35 Compound Engines 7280

STANDARD.

			H. P.
American Sugar Refin'g Co.,	12th order,	South Boston, Mass.,	150
Chicago Paper Trade Club,	1st "	Chicago, Ill.	125
" " "	2d "	" "	125
Boone Electric St. Railway Co.	1st "	Boone, Ia.,	125
" " " "	2d "	" "	125
" " " "	3d "	" "	125
Spreckles Sugar Refinery,	68th "	Philadelphia, Pa.,	100
Illinois Central R. R.,	2d "	Chicago, Ill.,	75
Crescent Steel Co.,	12th "	Pittsburgh, Pa.,	75
Wyman Flint & Sons,	2d "	Bellowa Falls, Vt.,	75
G. Amsinck & Co.,		New York,	75
Gov't Dep't of Bolivar,		Cartagena, S. A.	60
Warder, Bushnell & Glessner,	2d "	Springfield, Ohio.	60
W. J. McCahan Sug. Ref. Co.,	1st "	Philadelphia, Pa.,	60
" " "	2d "	" "	60
" " "	3d "	" "	60
" " "	4th "	" "	60
G. Brulay,		Brownsville, Texas.	45
Riverside Iron Works,	3d "	Wheeling, W. Va.,	45
Philadelphia and Reading R. R.,	12th "	Port Reading, N. J.	35
Westinghouse Air Brake Co.,	34th order,	Wilmerding, Pa.,	25
Clinton Wire Cloth Co. (K),	2d "	Clinton, Mass.	25
Girard Iron Co.,		Girard, Ohio,	25
W. J. McCahan Sug Ref. Co.,	5th "	Philadelphia, Pa.,	25
" " "	6th "	" "	25
" " "	7th "	" "	25
" " "	8th "	" "	25
" " "	9th "	" "	25
Chicago, Mil. & St. Paul R. R.	8th "	Milwaukee, Wis.,	15
" " "	9th "	" "	15
Cumberland Mfg. Co.,		Boston, Mass.,	15
Baltimore Electric Refining Co.,	6th "	Baltimore, Md.,	15
Peoria Gas Light Co.,	3d "	Peoria, Ill.,	15
Lawrence Machine Co.,	67th "	Lawrence, Mass.,	10
Chicago City Railway Co.,	6th "	Chicago, Ill.,	5
So. Bethlehem Gas & Water Co.,	2d "	So. Bethlehem, Pa.,	5
Unknown,		Chicago, Ill.,	5
Boston Electric Light Co.,		Boston, Mass.,	5

38 Standard Engines, 1965

JUNIORS.

			H. P.
F. J. Carey & Co.,		Gansevoort, N. Y.,	50
Fond du Lac Lt. and Ry Co.,		Fond du Lac, Wis.	50
Monroe-Shafer Shoe Mfg. Co.,		Brockport, N. Y.,	50
J. M. Campbell,	1st order,	Kingston, Ont.,	50
Detroit Dry Dock Co.	15th "	Detroit, Mich.,	35
Walter S. Davis,		Contoocook, N. H.	35
H. C. Durand,		Chicago, Ill.,	35
F. Otten & Sons,		Amsterdam, N. Y.,	35
Bauderie Cotton Mill,		Boldsville, N. C.,	35
Pittsburgh Reduction Co.,	8th "	New Kensington, Pa.	35
Herbert O. Allen,		Detroit, Mich.,	25
Shiffler Bridge Co.		Pittsburgh, Pa.,	25
Dry Dock Engine Works,	3d "	Detroit, Mich.,	25
J. L. G. Vale & Sons,		Elgin, Can.,	25
Pennsylvania R. R.	64th "	Camden, N. J.,	25
Pennsylvania Iron Works,	15th "	Pennsgrove, Pa.,	25
Bethlehem Gas Co.,		Bethlehem, Pa.,	25
[illegible]		Paris, France,	25
G. Steigmaier, & Bro.,	1st "	Philadelphia, Pa.,	25
"	2d "	" "	25
Montana Commercial Co.,		Chicago, Ill.,	25
Pittsburgh Reduction Co.,	7th "	New Kensington, Pa.,	15
T. & J. Robert,		Liege, Belgium,	15
H. Rawson Trask Co.,	2d "	Newburg, N. Y.,	15
J. M. Campbell,	2d "	Kingston, Ont.,	15
Lancaster Mills		Clinton, Mass.,	15
Independence Fuel Co.,		Chicago, Ill.	15
American Wood Board Co.,		Schuylerville, N. Y.,	15
Whitall, Tatum & Co.,	11th order,	Millville, N. J.,	15
George F. Ott,		Philadelphia, Pa.,	10
John Shillito Co.,	2d "	Cincinnati, Ohio,	10
Detroit Electrical Works,	4th "	Detroit, Mich.,	10
Albany & Troy Steamboat Co.,	1st "	Albany, N. Y.,	10
" " "	2d "	" "	10
Medical & Surg. Sanitarium,		Battle Creek, Mich.,	10
New Gaynor Electric Co.,		Jeffersonville, Ind.,	10
Fontaine Crossing Co.,	9th "	Detroit, Mich.,	5
Bailey & McKennon,		Washington, Pa.,	5
U. S. Government,	31st "	St. Louis, Mo.,	5
Edison Spun. Col. Lt. & P. Co.		New York,	5
Shelbyville Gas. Lt Co.,		Shelbyville, Ind.,	5

41 Junior Engines, 900

SUMMARY OF ORDERS FOR 60 DAYS.

Compound,	35 Engines,	7,260 H. P.
Standard,	38 "	1,965 "
Junior,	41 "	900 "
TOTAL, -	114 ENGINES,	10,125 H. P.

Removal!!

On and after May 8, 1893, the

REDDING ELECTRIC COMPANY,

may be found in their new and commodious quarters,

No. 336 Congress St.,

where, with increased facilities for handling their rapidly increasing business, they solicit your further orders.

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ENGINEERS, FOUNDERS AND MACHINISTS,

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Having one of the largest **FOUNDRIES** in the West, and one of the best constructed **MACHINE SHOPS** in the country, the equipment of which is thoroughly modern and complete throughout, we are prepared to cast and finish

Pulleys, Sheaves, Fly-Wheels, etc., of any diameter up to 20 feet, with any width of face.

Gearing of all styles and sizes

Hangers of light and heavy pattern.

Shafting up to 16 inches in diameter, and of 20 feet lengths.

Friction Clutches capable of transmitting any required H. P.,

Pillow Blocks, Collars, etc., and will be pleased to submit estimates for any machinery required in above lines.

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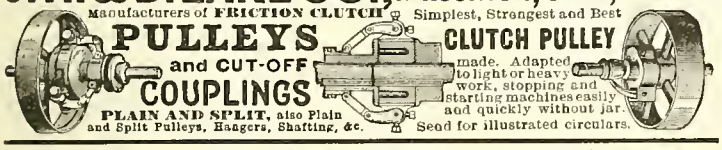
Manufacturers of **FRICTION CLUTCH** Simplest, Strongest and Best



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CLUTCH PULLEY made. Adapted to light or heavy work, stopping and starting machines easily and quickly without jar.

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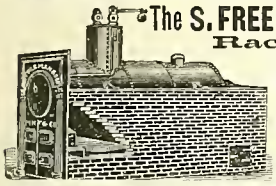

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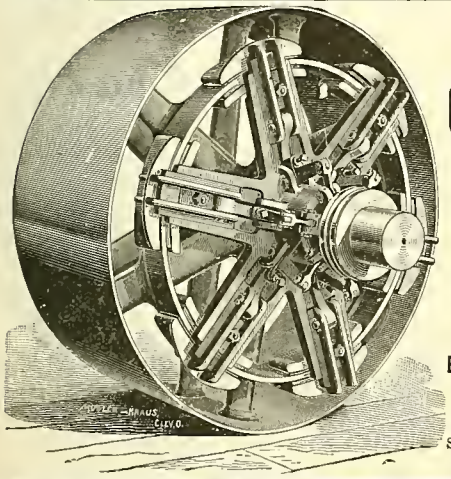

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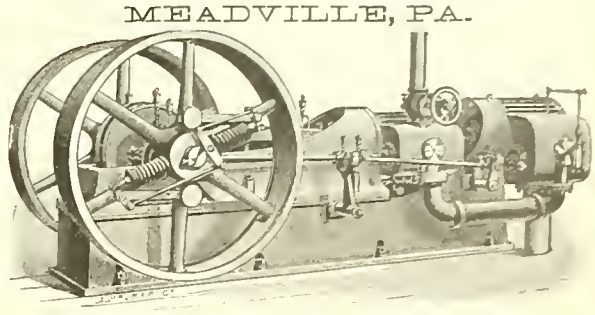

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"Dick & Church" Automatic Cut-off Engines.

15 Cortlandt St., NEW YORK. 619 Rookery Building, CHICAGO.

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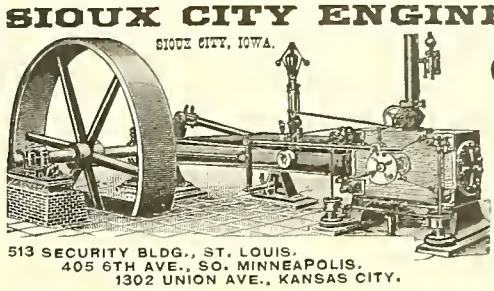

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Complete Plants Furnished.

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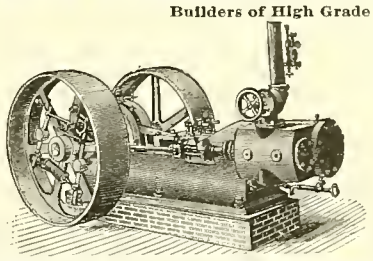

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EXCLUSIVE DESIGNS.
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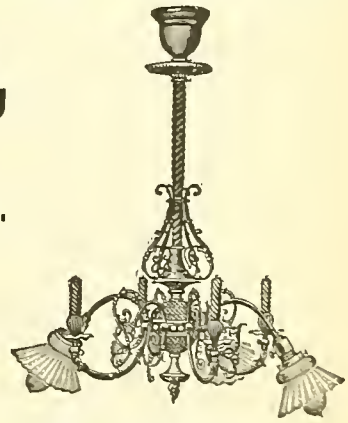

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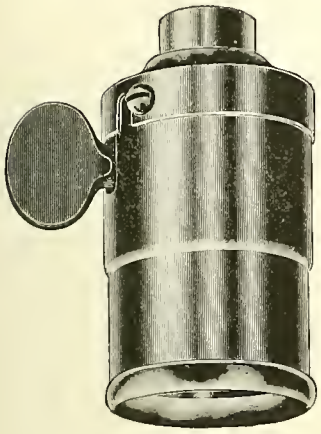

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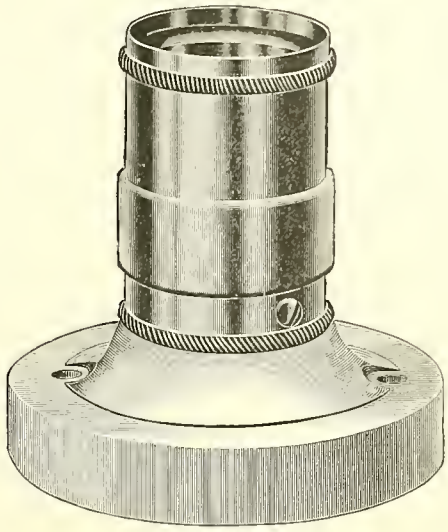

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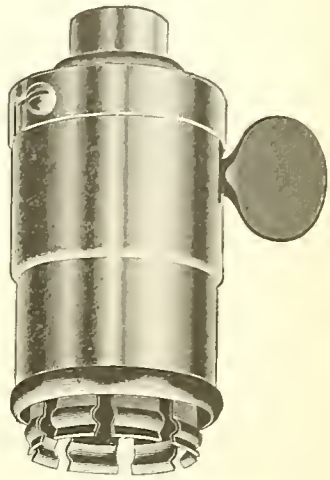

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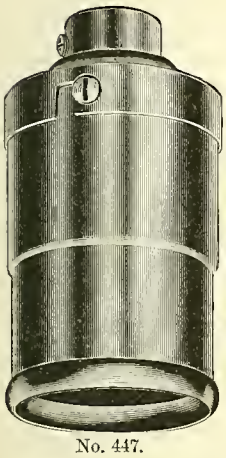

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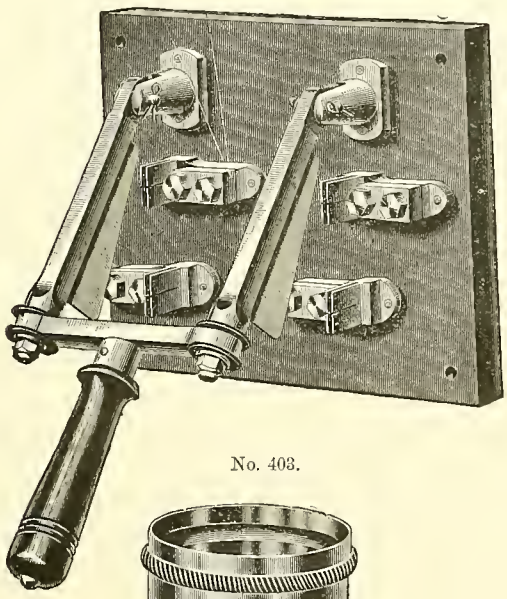

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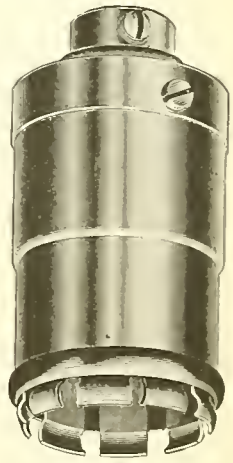

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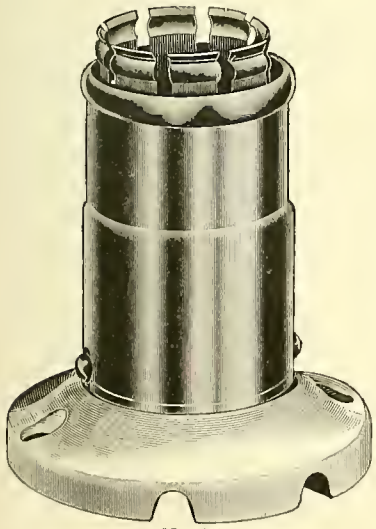

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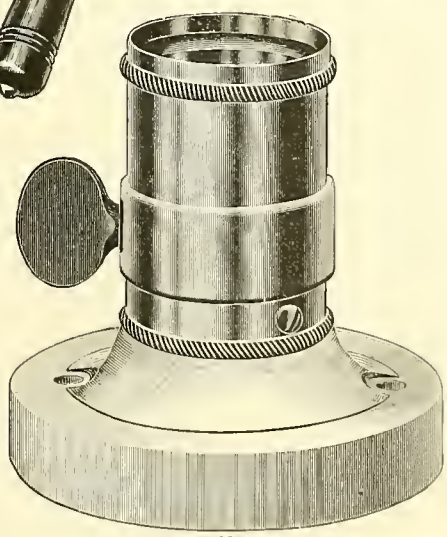

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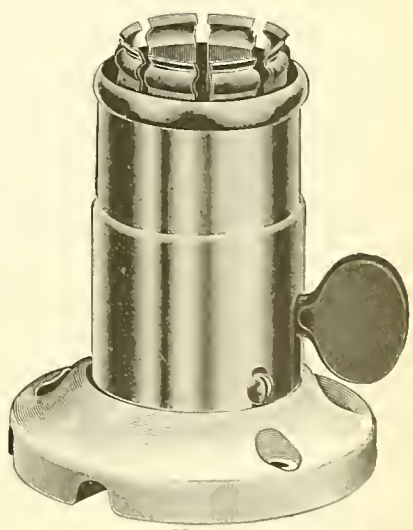

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On your Switch-Board.

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WIRT AMMETERS.
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The Standard and Most Reliable. Pays for Itself in Saving of Lamps.

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All one piece—
No Soldered Ends.
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SHIELD BRAND
Moisture-Proof
LINE WIRE.
Pages 6 to 9.

The Only Moisture-Proof (not rubber covered) Line Wire on the Market.

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Standard Red Core Rubber Covered
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Solid Moisture-Proof Insulation.
Lightning-Proof.

Highest Efficiency, Closest Regulation, Most Convenient to Handle.

HIGH INSULATION BRACKETS.
See Pages 43 to 48.

Strong, Graceful.
Made from Carefully Designed Patterns.

W-W Lightning Arrester.
The Simplest Made.

Protects your Line and Dynamos. No Magnets, no Springs, no Swinging Balls.

The New Sunbeam Lamp.

The Highest Economy combined with Long Life and Efficiency.

The Wirt Dynamo Brush.

Saves the Commutator, and Prevents Sparking and Cutting.

The Only Brush Built on Scientific Principles.

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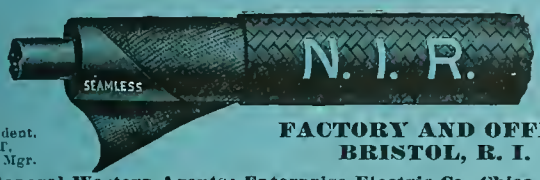

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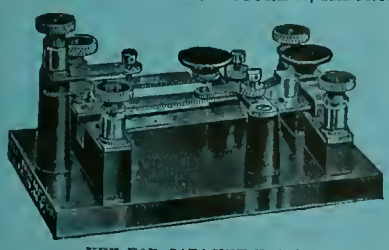

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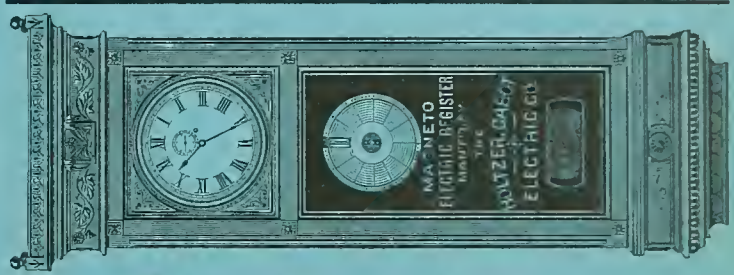

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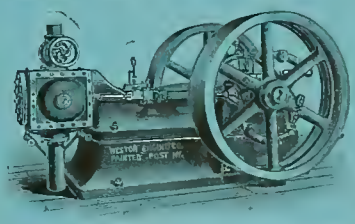

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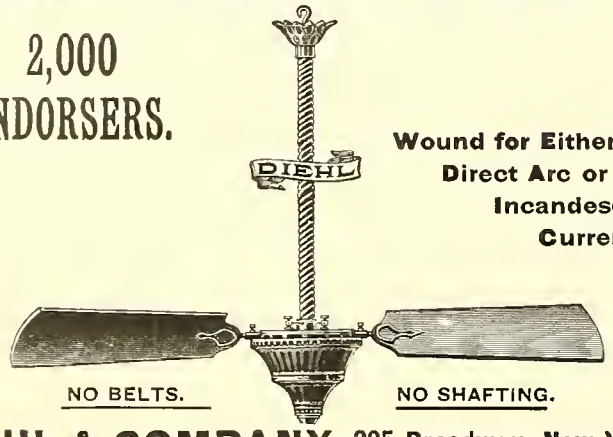

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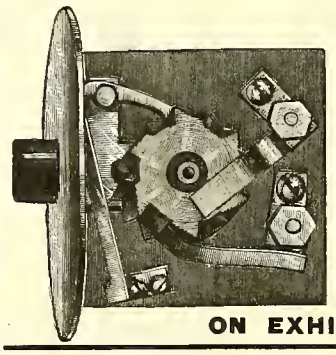

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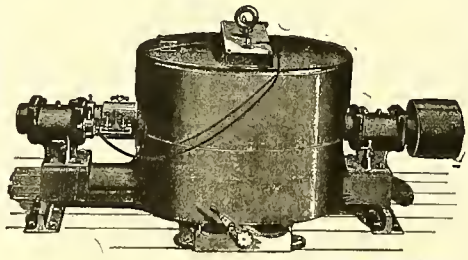

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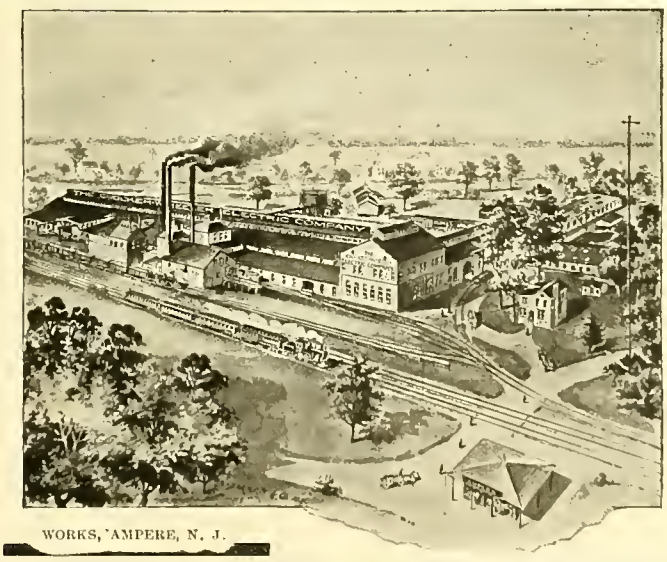

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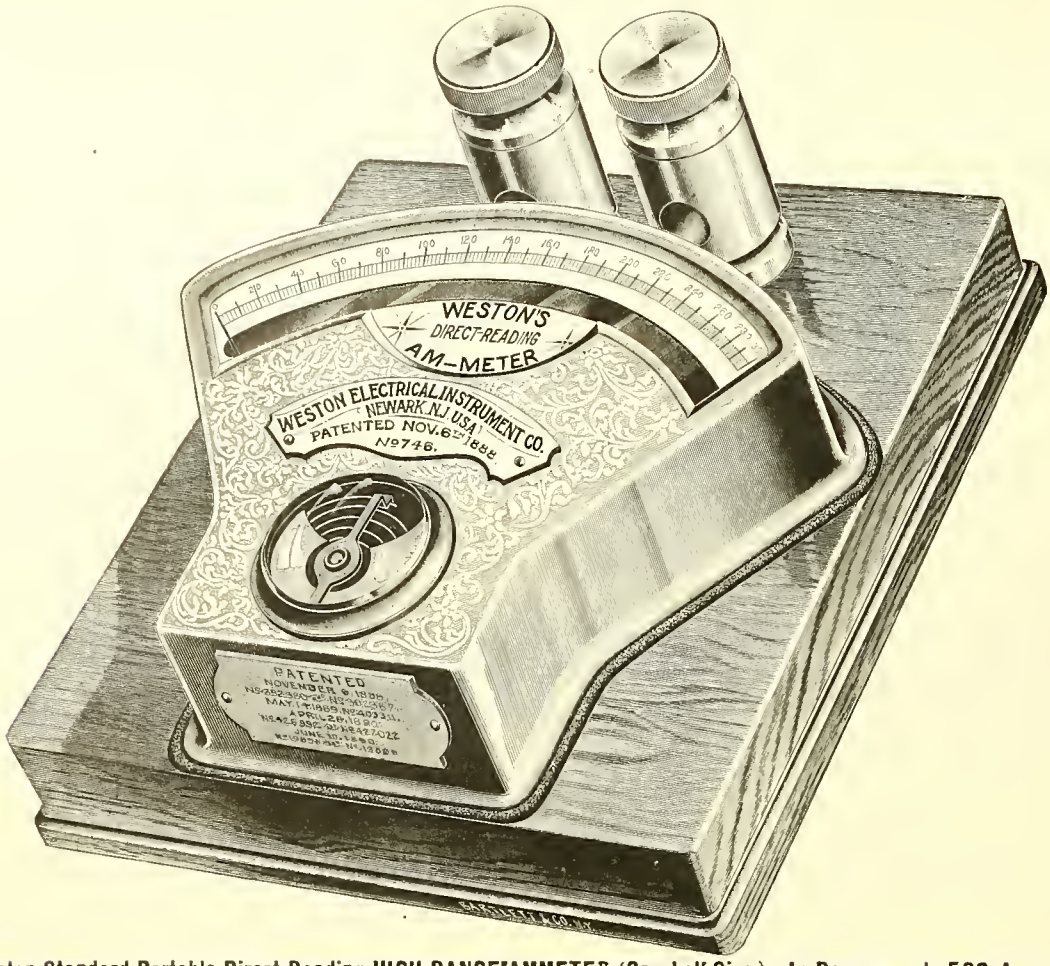

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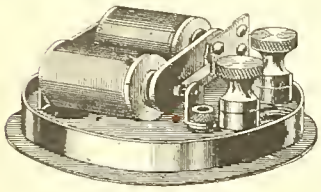

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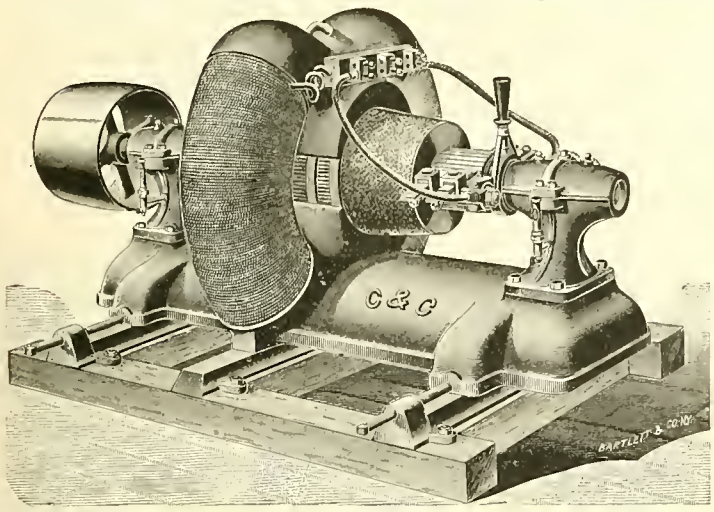

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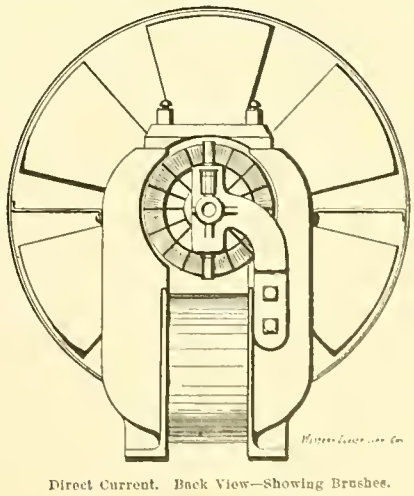

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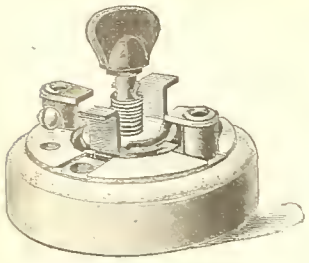

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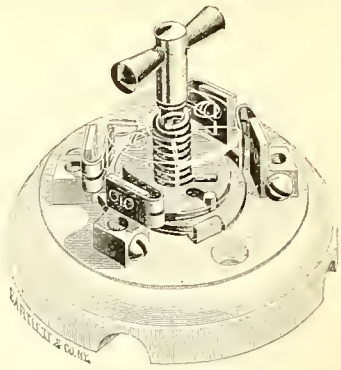

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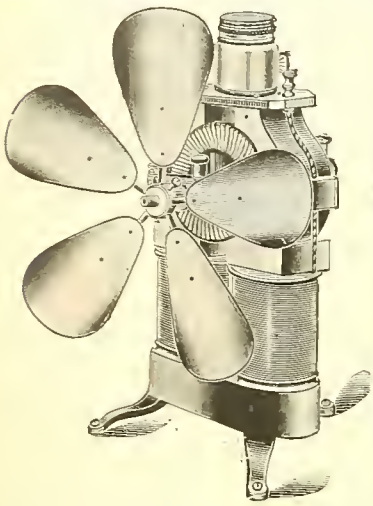

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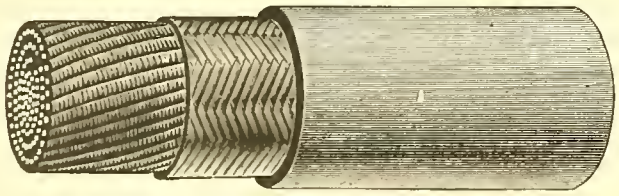

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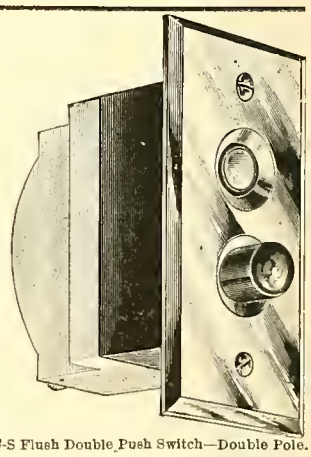

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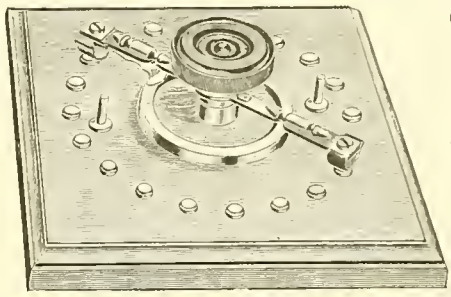

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LOW TENSION ALTERNATING CURRENT ARC LAMPS.

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CUSHING & MORSE, General Western Agents,

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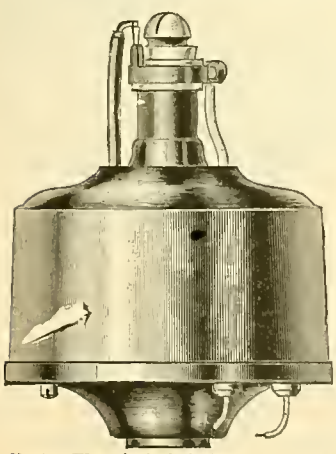

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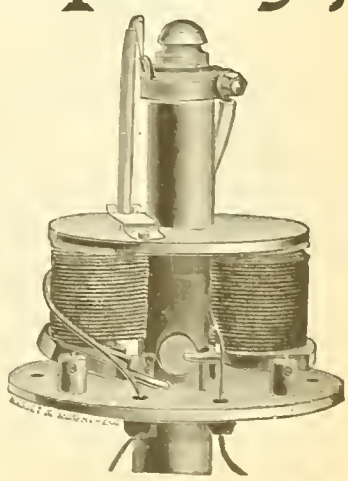

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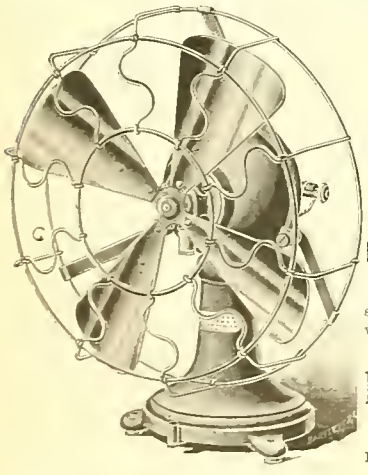

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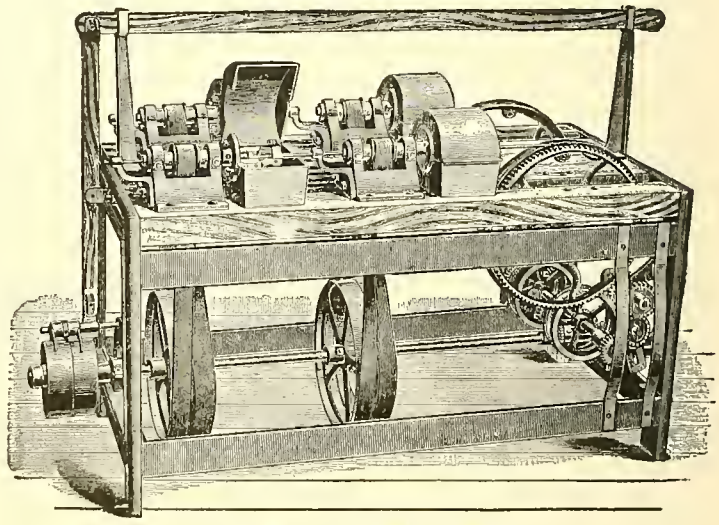
PROVIDENCE, R. I., U. S. A.

H. N. FENNER, Treasurer and General Manager.



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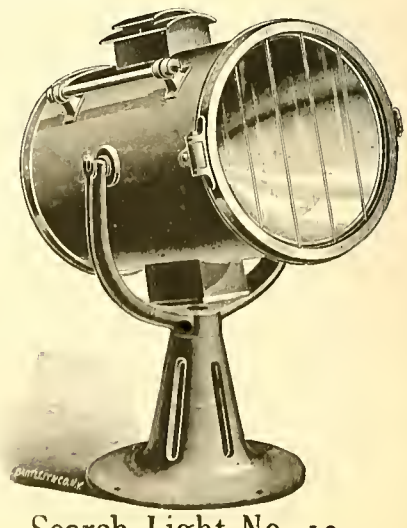

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PRICES.

8	C. P.	$0.30	20	C. P.	$0.35
10	"	.30	25	"	.35
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DISCOUNTS.

Ten (10) per cent. to Central Stations.

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Ten (10) cents for every burned-out lamp returned unbroken to factory.

EFFICIENCY.

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TWENTY PER CENT.

Shipments are now being made.

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ALTERNATING VOLTMETERS and AMMETERS,

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16 SIZES CARRIED IN STOCK

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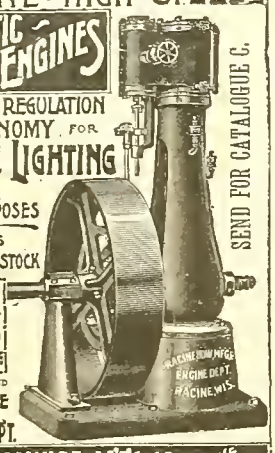
SEND FOR CATALOGUE C.



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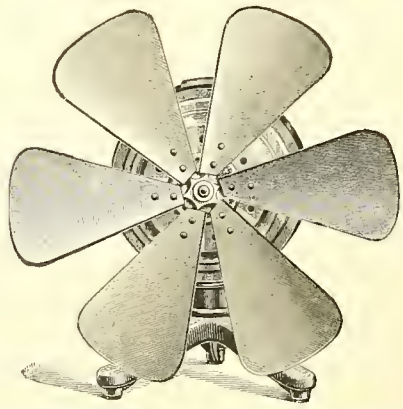

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WILL KEEP MOTHER GOOD LOOKING,
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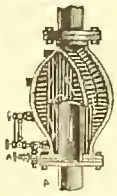

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Send for Circular and Cornell test report.

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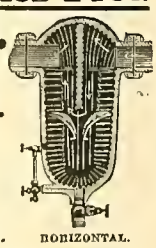

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The WADDELL-ENTZ COMPANY,

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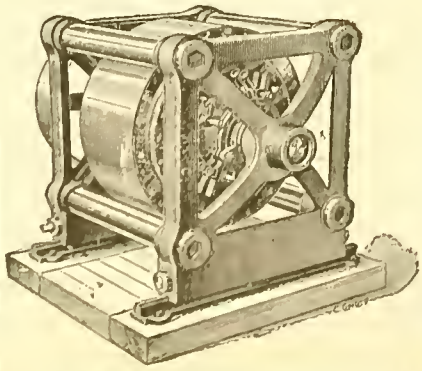

Improved Slow-Speed Generators and Motors. "DIRECT-DRIVEN" Slow-Speed Generators for Electric Lighting and Power. Low Running Expense. Insulated Wire and Flexible Cords. Estimates furnished. Isolated Plants a specialty.

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Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, MAY 27, 1893. No. 21

Electricity at the World's Fair.

To the practical man there few plants in the electricity building that will appeal more strongly than that of the Fort Wayne Electric company, which is illustrated on this page. The installation also has the distinction of being one of the first in the department to be completed, and it now carries a considerable proportion of the arc and incandescent lamps burning in the building. The plant is located in the southwestern portion of the building, on the ground floor, in the space known as section M. It is especially noteworthy from the fact that, although confined exclusively to the products of the Fort Wayne company, it forms a working exhibit of nearly every system of electric lighting in commercial use, including high and low tension and alternating arc lighting and direct current and alternating incandescent work. One dynamo is also shown that may be run on the three-phase system. Power is furnished by two Wood direct current motors—one of 125 horse power and the other of 80—which take current from the 500 volt circuits supplied from the company's generators in machinery hall, in which building the company also has an exhibit of fourteen Wood arc dynamos, which from a portion of the Exposition company's service plant. These two large motors drive a fine line of countershafting supplied by the Falls Rivet & Machine company of Cuyahoga Falls, O., which is completely equipped with friction clutches, shaft couplings and all the needful mechanical devices for power control. From this line of shafting are driven a Slattery 1,300 light alternator, a Wood 1,500 light alternator, a Wood 40 light arc machine and two Wood direct current incandescent dynamos, one of 400 lights and the other of 250 lights capacity. The Slattery machine is of the familiar type, as are also the Wood continuous current incandescent and arc dynamos. The Wood alternator, however, is a new machine and a separate view of it is given in Fig. 2. This dynamo is iron-clad and of the slow speed type. High claims are made for its efficiency, and particular attention has been paid to the ventilation of the armature, which is said to be indestructible. The lines of the machine are very graceful and it presents an extremely handsome appearance. The exhibit includes a number of other dynamos in addition to those enumerated. Among these is a 120 light Wood arc dynamo, wound for a maximum potential of 6500 volts. This is thought to have the greatest capacity of any arc machine yet constructed. It is not a pleasant machine to handle, however, as may be readily imagined, and is probably too dangerous for ordinary commercial use. It does not differ from the ordinary Wood arc dynamo in appearance, although somewhat larger. One interesting feature of the exhibit is shown in Fig. 3, which represents a small alternating current dynamo built by James J. Wood in 1879, and which in 1880 was awarded the medal for superiority at the American Institute Fair. The machine is mounted on a wooden beach and is driven by a Wood motor of 1½ horse power capacity supplied with a 500 volt current by concealed wires. The little dynamo is equipped with a commutator, rendered extraordinary by the fact that it is so arranged that either direct, alternating or three-phase current can be taken from it without stopping the machine to perform the necessary manipulation. The dynamo is also remarkable in that, although constructed thirteen years

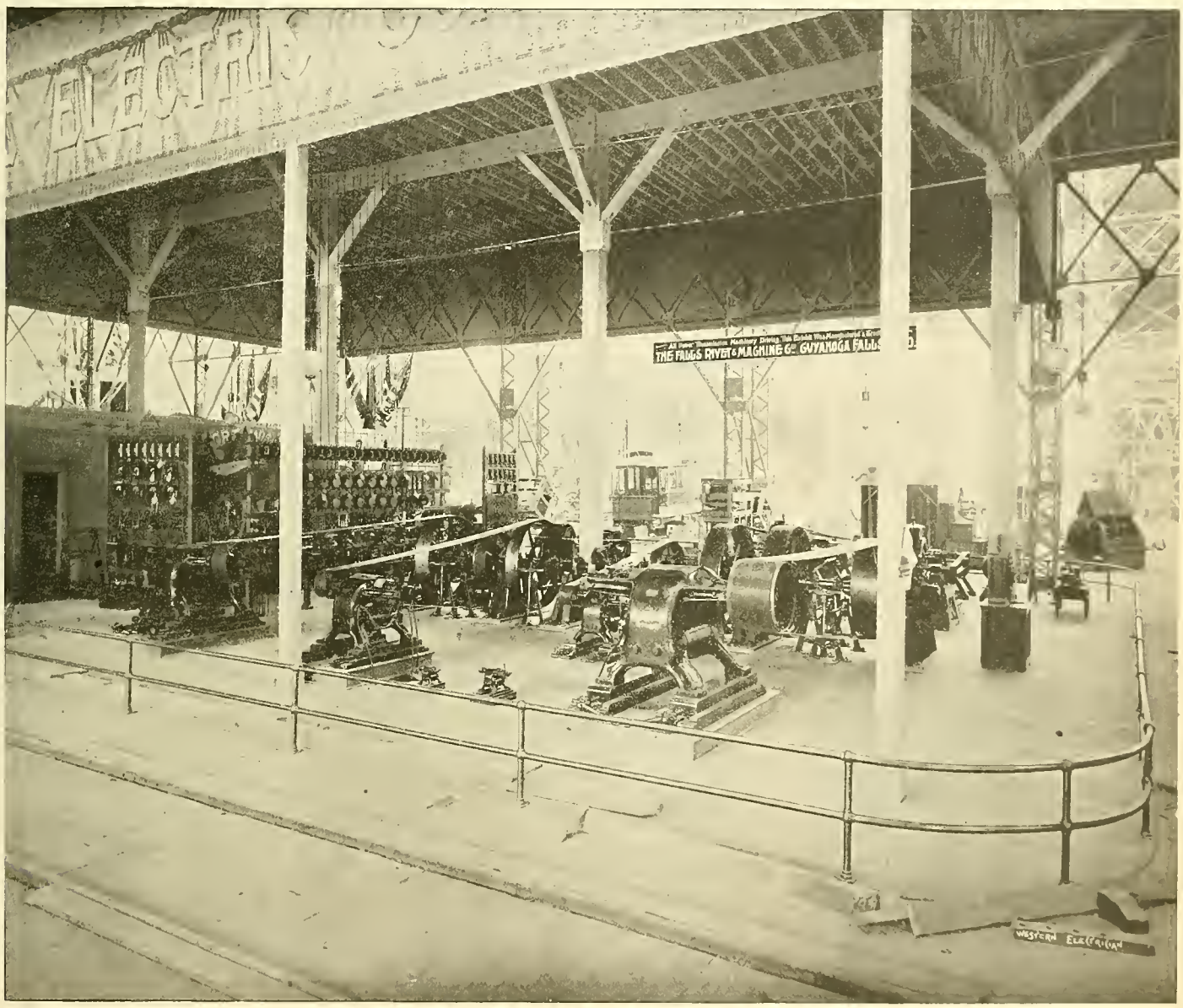

FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.—FORT WAYNE PLANT, ELECTRICITY BUILDING.

ago, it contains all the essential features of the most modern dynamos. The armature is iron-clad, the field magnets are multipolar and cast in one piece, and the internal resistance, measured from binding post to binding post, is but one ohm. It gives ten amperes of current and 50 volts pressure at 1,700 revolutions per minute. The total weight is 86 pounds. The commutator is interlocking and can be connected to produce the different varieties of current enumerated. The dynamo can also be used to run three independent circuits. As shown in electricity building the sturdy little machine operates a direct current arc lamp, shown in the illustration, to the wonder and delight of spectators. This historic dynamo is well and compactly built and does not differ greatly from the alternators of the present day. It is worthy of a visit from all interested in the progress of electricity. The plant includes three switchboards—one for the power circuits, another used as a distributing board for incandescent circuits, and an arc switchboard. The second is the most interesting. It is a skeleton framework of ash, arranged for both direct and alternating current circuits, and is susceptible of 12 combinations. Beyond the switchboards is a rack containing 26 varieties of arc lamps. Taken altogether, the exhibit is valuable and instructive. It reflects much credit on E. A. Barnes, the gentleman who designed and installed it and who is now in charge.

Chief Barrett of the department of electricity has issued an order giving notice of the promotion of J. W. Blaisdell to the position of general superintendent of the department of electricity, ranking next to himself and Assistant Chief Hornsby. Mr. Blaisdell is an affable and accomplished gentleman, and his friends will rejoice in his advancement.

The office of the operating staff of the exposition electrical service plant has been located in the southwestern corner of machinery hall, near the center of the plant and adjacent to the block of Standard arc machines. This department is under the direction of the following named officers: Superintendent of operation, J. H. R. Ward; assistant superintendents, H. M. Reynolds, Wynn Meredith, Sidney Sprout. When the plant is in complete running order about two hundred dynamo tenders, oilers, trimmers and "trouble men" will be employed.

The meager display made by England in the electrical department, taking up something less than 400 square feet, is generally deplored, although the English have no one but themselves to blame, as is recognized by the special correspondent of the London *Daily News*, who says: "We come out poorly in the superb department of electricity. The Germans, who have been pouring out money like water, are masters of the situation, apparently, here. An eminent American electrician in Chicago became (for an American gentleman who has been a soldier) quite emotional as he deplored to me the fact. He lamented the absence of the chairman of the committee, Mr. Preece, at the opening, and thought England ought to be better represented by electrical exhibitors. The fact is we sing small in this department, and perhaps it is useless to inquire why. The explanation, if wanted, must be sought for at home, for Sir Henry Wood and others did all they could to produce a better result."

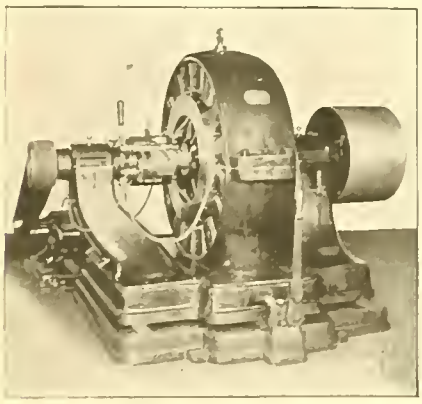

FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.—NEW WOOD ALTERNATOR, ELECTRICITY BUILDING.

The American Society of Civil Engineers has appointed a committee consisting of Edward P. North, L. L. Buck and Foster Crowell to entertain and enlighten foreign engineers visiting this country to see the World's Fair and passing through New York. Among other societies the British Institution of Electrical Engineers has been invited to share the civil engineers' hospitality at their club house, 127 East Twenty-third street, New York.

Of great popular interest will be the large display of phonographs and phonographic appliances shown by the North American Phonograph company in the southwestern corner of the gallery of electricity building, a view of which is given in Fig 4. A particular effort is made to show the commercial possibilities of the phonograph. One section is devoted to an exploitation of the machine for use in business offices in connection with the typewriter in answering letters, thus doing away with stenographers. The communication is spoken into the phonograph at the convenience of the proprietor or manager, and the cylinders are then laid aside for the young ladies manipulating the typewriters, whose phonographs are geared to a speed admitting of the transcription of the letter on the typewriter without interruption. In another space is shown the use of the machine for educational purposes in class work, as now conducted in some of the large schools, and also for the purposes of teaching languages, for which it is especially adapted. The pleasure and profit to be obtained by the employment of the phonograph in the home is also demonstrated. Phonographs of all descriptions are displayed, from the original tin-foil type to the present perfected machine. The very first phonograph ever constructed, however, is not shown, as that machine is in the possession of the Kensington Museum, in London, which would not allow it removed. A large picture of this interesting relic has been secured for the exhibit, however, and from it the illustration presented in this issue, Fig. 5, has been reproduced. The display is essentially an Edison one, and pictures of the great inventor form a prominent part of the handsome decorations. A number of attractive young ladies, who are thoroughly up on the intricacies of the instrument, add greatly to the enjoyment of visitors. The exhibit is in charge of P. R. Lombard, who hopes to add to his attractions at a later date Edison's late invention, the kinetograph, and an authentic phonographic message from the pope. A number of coin-controlled phonographs for the entertainment of the public are provided in the northeastern bay, on the ground floor of the building.

THE WESTERN ELECTRICIAN

LAKESIDE BUILDING CHICAGO

6 ELECTRICITY AT THE WORLD'S FAIR.—SPECIMEN OF CABLE TELEGRAPHY, ELECTRICITY BUILDING. FIG. 6.

Another display that excites much attention from the average visitor is that of the Commercial Cable company at the center of the western gallery of the electricity building. Nine-tenths of the people have but the vaguest idea of the manner in which telegraphic messages are transmitted under the sea between America and Europe. A visit to this exhibit clears up the mystery, however, for all of the cable company's operations are illustrated by models or actual demonstration. The most interesting feature is the improved siphon recorder, developed by Charles Cuttriss, which is the machine employed by this company for transmitting and receiving messages. In this instrument the principal parts are a light rectangular coil of silk covered wire and a powerful magnet. The coil is suspended between the poles of the magnet, and when excited by the electric current from the cable, swings on a vertical axis. Its movements are recorded on a paper ribbon drawn at a uniform speed before the point of a fine glass siphon no thicker than a human hair, which conducts a stream of ink from a reservoir to the paper ribbon. The marking end of the siphon responds to and multiplies every movement of the coil, and leaves on the ribbon an inky trail, which is an exact and permanent record of the movements of the coil under the influence of the currents from the cable. The coil is pivoted in jewels, and its motion controlled by magnetism so applied as to take the weight of the coil off the pivot and hold the coil almost suspended in the air, thereby securing the maximum freedom of motion and of control. This method of controlling recorder coils renders them so delicate that a speed of 250 to 300 letters per minute is maintained. Visitors are presented souvenirs in the shape of messages transmitted through the siphon recorder, with the characters indicated by ordinary Roman letters underneath. Those who are not familiar with cable telegraphy will be interested in the sample "inky trail" of the recorder presented in Fig. 6. The exhibit, which is in charge of H. F. Harrington and E. Desnoyée, contains many other interesting features, and is well worth a visit.

Chief Barrett has written a circular letter to exhibitors, requesting them to note any errors that may have crept into the first edition of the catalogue, in order that the list may be correct in the forthcoming edition.

The Ansonia Electric company has transformed the third floor of its building, at the corner of Michigan avenue and Randolph street, Chicago, into club rooms, to which it extends a cordial welcome to visiting electrical men. All the conveniences of club life will be provided. The arrangements for the carrying out of this hospitable scheme have been placed in the hands of George B. Shaw. Mr. Shaw has also charge of the exhibit made by the Ansonia Electric company, which can be found in the attractive pavilion occupying the north end of the gallery in the electricity building.

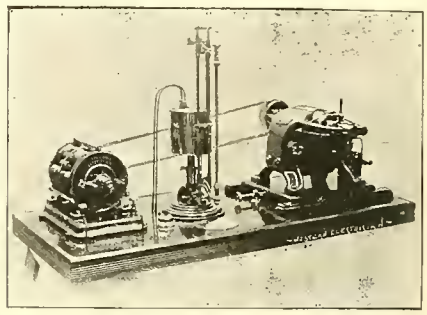

FIG. 3. ELECTRICITY AT THE WORLD'S FAIR.—HISTORIC WOOD DYNAMO, BUILT IN 1879, ELECTRICITY BUILDING.

On Thursday evening a test was made of the electrical fountains, and the results were such as to warrant the prophecy that, when fully completed, the fountains will surpass anything of the kind ever attempted. The principal cause of delay now is in the pumps and hydraulic arrangements.

The most noted visitor at the Bell telephone pavilion last week was Prince Roland Bonaparte. The distinguished Frenchman was entertained by General Manager Hovey. He expressed great interest in the very complete telephonic display, particularly in the tests of the long-distance instruments.

Among the late exhibitors is the General Incandescent Arc Light company, which has space in the northeastern portion of electricity building, on the ground floor. An elaborate display of novel arc lamps is promised by Charles A. Noll, the general agent of the company.

Many of the most attractive and novel exhibits in electricity building are in the gallery, and visitors who neglect to ascend the stairs will miss some of the most striking novelties. The phonograph, kinetograph, telautograph, deep sea cables, electrical engraving machines, foreign telegraph displays and rare instruments are nearly all in the gallery. And who will care to go away without at least a peep at the headquarters of the paper that prints all the electrical news at the World's Fair, the WESTERN ELECTRICIAN? This attraction, too, is in the gallery in the northwestern portion of the building. The official designation of the space is Y-32. Don't forget the number.

Arrangements have been perfected for the operation of an electrically operated time-ball on a flagstaff surmounting the dome of the government building. It will drop precisely at 11 o'clock every morning, when it is noon at the Naval Observatory in Washington, from which the time is sent over Western Union wires.

A very successful evening illumination was given last Saturday. The attendance was larger than at any other time since the opening of the exposition, and the scheme of electric lighting was the most elaborate yet attempted. The northern electric fountain was running, but as the arrangements are not completed, little idea could be given of the effects that will be ultimately attained.

World's Congress of Electricians.

The following important announcement has been made by Prof. Elisha Gray, chairman of the World's Electrical Congress committee:

We have the pleasure to announce that in accordance with the expressed wish of the American branch of the advisory council of the World's Congress of Electricians, the secretary of state has appointed Profs. H. A. Rowland, Johns Hopkins University; T. C. Mendenhall, superintendent standard weights and measures; H. S. Carhart, Michigan University; Elihu Thomson, Lynn, Mass., and E. S. Nichols, Cornell University, to sit in the chamber of delegates as the duly authorized United States delegates.

While there are many electricians in the United States who could fill with dignity and credit to the profession

this honorable and responsible position, yet the profession is to be specially congratulated that the United States is to be represented by men of such high standing, both as gentlemen and members of the profession.

We also have the pleasure to announce that the Royal Commission has named W. H. Preece, Prof. S. P. Thompson, Prof. W. E. Ayrton, Major Cardew and Alexander Siemens as delegates from Great Britian.

There is every reason to believe that the success of the congress is now assured, and that all the important countries will be fairly represented.

The following self-explanatory telegram was received by Prof. Gray last week from Prof. Edwin J. Houston, the newly elected president of the American Institute of Electrical Engineers:

The American Institute of Electrical Engineers at its annual dinner assembly wishes to convey to you its desire for the success of the Electrical Congress and its intentions to lend all its energies towards that end.

Annual Meeting of the American Institute of Electrical Engineers.

The annual meeting of the American Institute of Electrical Engineers for the reception of the yearly reports, the election of officers and other business proceedings was held at the headquarters of the Institute, No. 12 West Thirty-first street, New York, at 4 P. M., Tuesday, May 16th. President Frank J. Sprague was in the chair. The reports of the treasurer and secretary were read. The finances of the association were shown to be in a healthy condition, there being a balance of several hundred dollars in hand. The membership of the Institute is now close on 700, as the secretary's report showed 673 on the list and 22 new members were elected at the council meeting. There is now such a demand for admission that the Institute hopes to attain a membership of 1,000 before it completes its tenth year.

The distribution of the official ballots by the secretary was followed by the distribution of what was announced as a "members' ticket," accompanied by a circular signed by about thirty members. By enclosing a stamped envelope, votes were no doubt secured from many who otherwise would have neglected their privilege. Out of a membership of 673 returns were received from 466, and of these 427 were counted, the remainder being thrown out for various defects. T. C. Martin and George A. Hamilton were appointed tellers and devoted several hours to their duty of counting, and the final result was announced as follows. President, Edwin J. Houston; vice-presidents, H. Ward Leonard, P. B. Delaney, William Wallace; managers, Charles Hewitt, William J. Hammer, Harris J. Ryan, J. J. Carty; treasurer, George M. Phelps. Under the new rule the secretary is elected by the council.

The vice-presidents whose terms expire in 1894 are: A. E. Kennelly, Nikola Tesla and Oscar T. Crosby; managers, Dr. Louis Bell, Herbert Laws Webb, Prof. Alfred G. Compton and James Hamblet. The managers whose terms of office expire in 1895 are Charles Wirt, Augus S. Hibbard, Dr. Michael I. Pupin and Charles P. Steinmetz.

During the counting of the ballots an extended discussion took place upon the question of holding regular meetings in other cities. It was brought up by Dr. Perrine, who is about to locate on the Pacific Coast, and who desired to ascertain what steps could be taken toward calling such meetings. The discussion was entirely informal, but elicited the fact that there was no objection to such a plan provided a sufficient number of members could be assembled to make the practice a success. Upon the reading of a preliminary report by the tellers announcing the vote for president as 236 for E. J. Houston and 145 for Thomas D. Lockwood, the meeting adjourned and the members reassembled at "The Arena," where about 75 sat down to the annual dinner. Professor Houston presided and appointed Past-president Sprague as toastmaster. Appropriate remarks were made by Messrs. Lockwood, Emery and Martin.

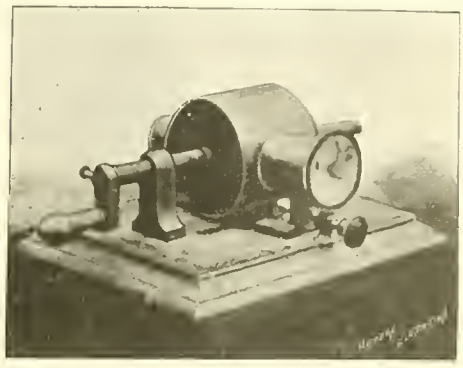

FIG. 5. ELECTRICITY AT WORLD'S FAIR.—EDISON'S FIRST PHONOGRAPH.

FIG. 4. ELECTRICITY AT THE WORLD'S FAIR.—PHONOGRAPHIC EXHIBIT, ELECTRICITY BUILDING.

The general meeting assembled at headquarters on Wednesday morning, and papers were presented as follows:

'On the Behavior of Fuse Metals in Direct and Alternate Current Circuits," by Charles P. Matthews, of Cornell University, Ithaca, N. Y.

"A Modified Deprez D'Arsonval Galvanometer," by Lieut. Charles D. Parkhurst, of Watervliet Arsenal, West Troy, N. Y.

"The Variation in Economy of the Steam Engine due to Variation in Load," by Prof. R. C. Carpenter, of Cornell University, Ithaca, N. Y.

"An Automatic Printing Speed Counter for Dynamo Shafting," by Prof. Geo. S. Moler, of Cornell University, Ithaca, N. Y.

After luncheon the following papers were read.

"A New Method and Apparatus for Measuring Conductivity," by E. G. Willyoung, of Philadelphia.

"The Heating of Armatures," by A. H. and C. E. Timmerman, of Cornell University, Ithaca, N. Y.

A. E. Kennelly then opened the discussion on the Provisional programme for the World's Electrical Congress, which was participated in by Messrs. Houston, Lockwood and Pope.

In order to avail himself of suitable apparatus, Dr. Pupin invited the members to meet in Prof. Chandler's room in Columbia College at 4 P. M., where he lectured on the "Practical Aspects of Electrical Resonance." The lecture was well received and the author was highly complimented upon his researches by Mr. Tesla who was present. The meeting then adjourned.

In the evening, on the invitation of the New York Electrical society, the members attended the lecture at Columbia College on "A Brief Glance at Electricity in Medicine," by Dr. W. J. Morton, in which some novel effects were shown to illustrate some possibilities at present but little known of the influence machine in electrotherapy. The lecture will be incorporated in the minutes of the Institute.

Friday afternoon was devoted by the electrical engineers to a visit to the Crocker-Wheeler new factory at Ampere, N. J., whither they were taken by a special train, and they were greatly interested in the equipment of machine tools with electric motors, whereby the necessity of belting and shafting is entirely avoided. The system was well shown in the machine shop where, in place of the ordinary shafting, a line of half inch bare copper rods twenty feet in length, and held in position by a special porcelain insulator runs the whole length of the shop. The rods are joined together by sleeve couplings and soldered, the pine board which carries them being fixed to the roof beams. The arrangements for taking off the current are perfect.

This visit brought to a close what has been a most successful meeting of the Institute. Its general programme was purposely made much less elaborate than usual, in view of the fact of the near approach of the Electrical Congress, and a great deal of the work was made to bear on matters the discussion of which will be resumed at Chicago in August. All the officers of the Institute are anxious that the Electrical Congress shall be a great success, and are bending every effort in that direction.

The committee on invitations to the congress availed itself of the fact that most of its members were in town to hold its latest meeting, and transacted a large amount of work, the results of which will be published in a week or two.

Distributing Niagara's Power.

Attention was directed in the last issue of the WESTERN ELECTRICIAN to the formation of a company for the electrical distribution throughout New York of power generated at Niagara Falls. Concerning the plan to compete with the local company at Rochester, which utilizes the water power of the Genesee River, the *Herald* of that city says:

Rochester capitalists interested in the organization of the Cataract Electric company, which proposes to bring electricity from Niagara Falls to this city and farm it out to manufacturers, and in fact to all who have any need for the fluid, do not seem at all disposed to talk just at present about their plans. A *Herald* reporter learned yesterday that the company had not yet been actually formed but that its projectors are sanguine of success and hope to file incorporation papers in the near future.

Men who think favorably of the enterprise are to be found on all sides. Some express a willingness to invest in the enterprise and yet are unable to say what the capital of it will be. When questioned they invariably refer their interrogator to Frank W. Hawley, of Pittsford, who undoubtedly is the prime mover in the scheme, but Mr. Hawley is hard to find, as he spends the greater part of his time in New York.

Henry C. Brewster, of the Traders' Bank, is another of the interested ones. While Mr. Brewster professes no great knowledge of electricity he thinks the scheme a practicable one, and under certain circumstances would put money into it. What these circumstances are and how heavily he would be likely to invest Mr. Brewster refuses to say. Within two weeks he thinks the organization of the company may be made public, but he would give no positive statement of facts.

Secretary Moss, of the Chamber of Commerce, knows none of the interested persons, but thinks the scheme capable of accomplishment. As evidence that electric power can be transmitted from Niagara Falls to this city he cites the mode of supplying Frankfort, Germany. The plant is located at Lauffen Falls, 100 miles distant, and supplies Frankfort with both light and power. As to the expense, compared with steam power, Mr. Moss was unable to speak.

Mr. Moss' opinion is at variance with that of the superintendent of the Rochester Electric Light company, 70 Mumford street. Quite naturally, he is not over enthusiastic concerning the scheme's success. He thinks the plan as yet impracticable, inasmuch as no cable has yet been constructed capable of carrying so great a voltage. He was in Buffalo Friday and talked with a gentleman controlling large manufacturing interests in that city as to the feasibility of using Niagara Falls electricity as motive power in

Buffalo. The manufacturer stated that at the prices announced, even should the scheme proved successful, it would be more expensive than steam, and he would continue using the latter.

City Surveyor McClintock was seen at his office in the City Hall. He said he was not in a position to make a statement concerning the matter, as his information in relation to the project was derived wholly from the newspaper reports. If practicable he thought the product would likely find a market here notwithstanding the water storage project. The competition thus created would be of great benefit to the city, and the city's growth in his opinion demands more power. He wishes the enterprise to succeed, but first looks for the acceptance of Niagara's force as a motive power by the manufacturers of Buffalo.

Concerning the Frankfort Lauffen experiments it may be said that the opinion entertained by many persons outside of the electrical fraternity corresponds with that expressed by Secretary Moss of the Rochester Chamber of Commerce. They do not realize that the experiments there made were not successful from a commercial point. It is to be hoped that the projectors of the enterprise have something more promising than the German experiments upon which to base their expectations.

Electricity in a Welsh Mine.

The first electric haulage plant in South Wales has recently been installed in the Abercanaid pit of the Plymouth company at Merthyr Fydfil. The installation was made for the purpose of hauling 500 tons a day, and as the mechanical power will replace 27 horses and as many men, the plant has attracted a very large share of attention in the Welsh coal mining districts, where economy in working is a matter of prime importance. The power station, which is shown in Fig. 1, is 61 feet in length, 32 feet in width, and 36 feet in height. It contains a 40 horse power compound engine, made by Marshall & Co. of Gainsborough, which by means of a fly wheel drives a Compton dynamo, the output of which is 180 amperes at 500 volts. Current is conducted down the shaft along the workings to a point three-fourths of a mile distant, where there is situated a hauling engine, Fig. 2, which is fitted with two drums, each of which is provided with a clutch and foot brake. The drum shaft is driven by spur gearing from a countershaft on which is a rope wheel grooved for six ropes of one inch in diameter. These ropes pass around a smaller pulley on a series wound Crompton electric motor which is operated by a current of 80 amperes at 450 volts.

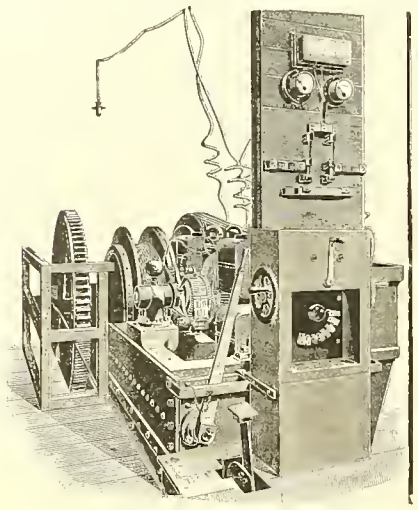

FIG. 2. ELECTRICITY IN A WELSH MINE.

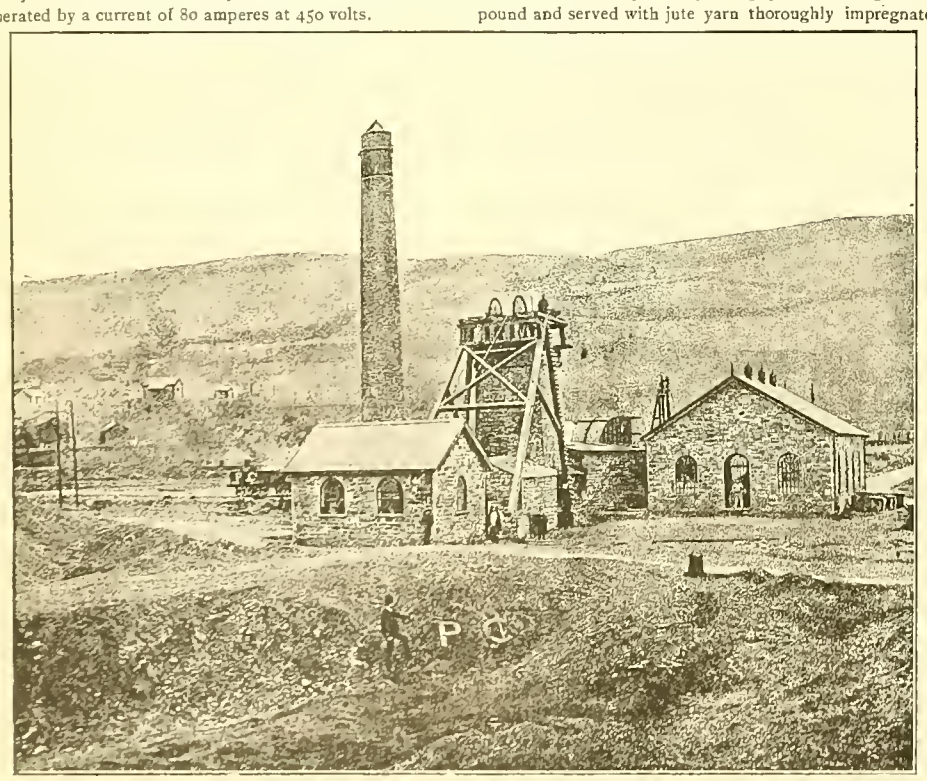

FIG. 1. ELECTRICITY IN A WELSH MINE.

It is governed by a Howell-Powsall switch, arranged to deal with currents of great pressure and magnitude without injurious sparking. The motor is mounted on the end of a wrought-iron frame, which forms a bed for the drum and spur gear. This plant will haul coal from three different parts of the pit, and although these are not far from the moter at the present time, it is expected that eventually coal will have to be dealt with from nearly a mile distant.

The Abercanaid pit is fortunate in being quite free from gas, so that no precautions have to be taken to prevent sparking at the commutator and switch. It is, however, liable to falls of roof and other accidents that might damage the conductor, if not efficiently guarded against. A very heavily armoured cable has, therefore, been laid down, of a length of 3,200 yards. It is carried down attached to the side of the shaft, and from the shaft to the hauling engines it is run underground along the roadway.

The conductor of the cable consists of 37 wires, each No. 14 S. W. G. of tinned copper, of 98 per cent. conductivity. The section of conductor is therefore .191 square inch. This strand is insulated by means of a solid sheath of vulcanized bitumen, put on in one operation under heavy pressure. This is protected by two layers of bitumenized tape, compounded, and over this a bedding of jute yarn is formed by two heavy servings, well dressed with preservative compound. On this are wound the two layers of steel wires which form the armor. The first consists of 24 wires, each .160 inch (No. 8 S. W. G.), laid right-handed; the second is of 30 wires of similar size, laid up left handed. This was supplied by Callender's Bitumen Telegraph & Waterproof company, London.

The cable is completed by being passed through compound and served with jute yarn thoroughly impregnated with Stockholm tar, and then dressed with asphalt compound. The diameter of the cable is 2 15 inches. It was made in lengths of 150 yards, each weighing, without the drum, about 3,000 pounds. Owing to the difficulty in handling the cable in the limited space available, it was not considered prudent to supply it in longer lengths. Each length was finished by a copper end-piece, which was sweated on to the conductor before being laid, and these end-pieces were subsequently bolted together and protected by strong cast iron boxes, which boxes were run in solid by insulating material. Any length can be disconnected for testing at a few minutes' notice, and reconnected without requiring any joining or soldering. In addition to the haulage plant, electric lighting is effected from the power station. There are 100 incandescent lamps of 16, 32 and 50 candle power, distributed about the engine house, pithank, screens, and various other positions on the surface. There are also twenty-five 32 candle power lamps distributed over 1¼ miles of village streets, and 100 16 candle power lamps fixed in various positions underground, along the main roadways, in the stables, etc. Figs. 3 and 4 were photographed by aid of electric lights, the latter being the pit bottom in the South Duffryn Colliery, and the former the underground engine plane at Abercanaid Colliery. The plane is worked with endless rope haulage, and as shown, is temporarily obstructed by the cables used in the electric lighting. The cuts are reproduced from London *Engineering*.

American Institute Badge.

The American Institute of Electrical Engineers has adopted an official badge, the design of which was selected by a committee composed of Dr. F. Benedict Herzog, Horatio A. Foster and William J. Hammer. It is neat and appropriate, and embraces the following characteristic features:

Franklin's kite, which demonstrated the identity between lightning and electricity, and represents static electricity. It is a recognition of America's first electriciana nd philosopher, Benjamin Franklin.

A diagramatic representation of Wheatstone's bridge, one of the most important pieces of electrical testing apparatus.

The galvanometer, another equally important piece of testing apparatus and which represents magnetism and induction.

The amber, of which the galvanometer is made, represents the first conception of electricity dating back to 600 years B. C., when Thales, the Greek philosopher, recorded the fact that amber, when rubbed, attracted light particles to it, and the Greeks worshipped it, believing the gods had endowed it with life and that it possessed a soul. In 1600 A. D. Dr. Gilbert, court physician to Queen Elizabeth, coined the word electricity from the word elektron, the Greek name for amber.

A. I. E. E. represents the initials of the American Institute of Electrical Engineers.

$C=\frac{E}{R}$ represents Ohm's law—a fundamental law in electrical work.

The pin is made of white enamel with the lettering and front portions in 18 karat gold and the back in 14 karat gold. The secretary, Ralph W. Pope, announces that the badges are now ready for distribution and can be procured by members.

Electricity in Medicine.

A remarkable lecture was given at Columbia College before the New York Electrical Society on the 17th inst. The subject was "A Brief Glance at Electricity in Medicine," and the lecturer was Dr. W. J. Morton, professor of diseases of the mind and nervous diseases and electrotherapeutics at the post graduate school and hospital, New York. Dr. Morton's standing as an expert in these branches in this country corresponds to that of D'Arsonval in France, and, as might be expected from the eminence of his reputation, the lecture brought together a most appreciative audience, in which were found some of the foremost medical and electro-therapeutic practitioners of the city. The subject was treated under the following heads: The Various Currents used in Medicine; The Properties and Applications of the Respective Currents; High Frequency; High Potential Currents; Electrostatics of Franklinism Tesla Currents, from Alternators, Air-gap, Condenser and Induction Coil; Morton Currents, from Influence Machine, Air-gap and Condensers; D'Arsonval Currents; Sinusoidal Currents, from Alternating Dynamo Machines.

Premising that the pursuit of truth was to electricians, who dealt with electricity applied to inanimate objects, a far less onerous task than that undertaken by electro therapeutists, who, outside of the necessity of a thorough technical equipment in the physics of electricity, were confronted with the perplexing problem of the laws which govern life in animate objects—the problem of biology—Dr. Morton described the effects of the electric current according to the divisions into which it has been classified for medical use, viz.: Galvanism, Faradism and Franklinism. An investigation then followed into the nature of the gross substance, the human body, to which the current had to be applied and the reactions of electricity upon it, and an examination was made of the principles, the instruments and the method of application, the knowledge of which constitutes the science of electro therapeutics. The physical properties of the current were classified into heat, light, magnetic, induction, chemical, electrolytic and cataphoric, and the physiological properties into contraction of proto-

plasm, excitation of nerve and muscle and electrotonus. In using electricity to cure disease, the physician was compared to a huntsman, who has a certain number of arrows in his quiver, each adapted to different purposes. He selects an arrow—a property of the current—and projects it against a disease or morbid condition. "At least," said the lecturer, "that is what he should do; but it is unfortunately a fact that physicians are wofully ignorant about

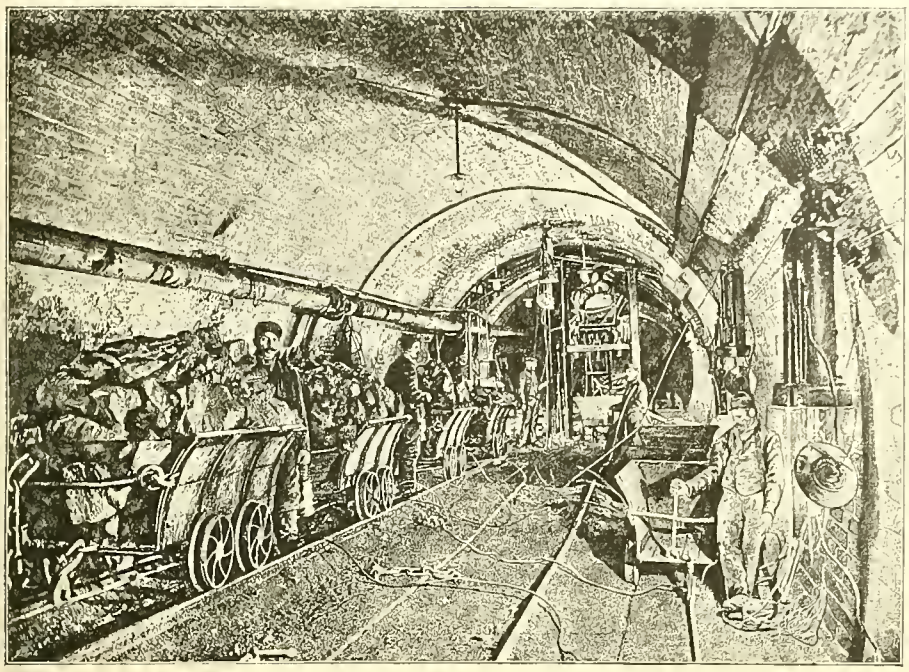

FIG. 3. ELECTRICITY IN A WELSH MINE.

what electricity will do upon inanimate and still more so upon animate matter. The general impression seems to be that electricity is to be injected into a human being by a small sponge electrode, much as one would inject a medicated fluid in through the skin by a hypodermic needle, and it is then to run about the system, hunt up the diseased spot, make a diagnosis, and chase out the disease, much as a ferret might run a rat out of a hole."

In detailing the electrical discoveries which have been silently working a revolution in various branches of medical practice, the lecturer said that some recent advances in the application of electrolysis are of great value and deserve to be better known. One of these, termed metallic electrolysis of soluble metals, has been taken up by Gautier of Paris, and developed into a curative system which has before it a brilliant future. An iron needle connected to the positive pole, plunged into human tissue, is quickly attacked by the oxygen and chlorine set free at this pole. It is converted into oxychloride of iron, a double salt, and is soon completely destroyed. The same is true of any metal attacked by oxygen or chlorine. A copper needle or bulb is converted into oxychloride of copper, zinc into oxychloride of zinc, and so on. The general effect of this treatment is antisepetic and healing, and it is of immense benefit in gynaecological work, in unhealthy ulcerations, tumors and dischargiog cavities. But the direction in which it will most probably appeal to the general public is its marvelous results when applied to catarrh. The results that are already on record would induce the belief that almost any case of catarrh will yield to this treatment in the hands of a skillful practitioner, and in its speedy effects it presents a very agreeable contrast to the tediousness of conventional treatment. Next to electrolysis, cataphoresis, or the flow of a liquid with the current from the positive toward the negative pole, is the most important property of the galvanic or continuous current. This cataphoric property of the current renders available a very interesting method of introducing medicine into the human body and blood stream through the skin or mucus membrane. The process is termed "cataphoric medication." In this manner iron, mercury, quinine, morphia, cocaine and a further great variety of medicines may be caused to affect the patient without entering the stomach. The practice is of great value to produce local anaesthesia by cocaine, and also in many cases, as in skin diseases, where a potent local effect of the medicine is desired. There is no good reason why a "medicated bath" should be an adjunct of quackery. If the medicated water of the bath is made the positive electrode, a patient in this bath, with hands and arms out of it, and in connection with the negative electrode, will receive by cataphoresis through the skin, a large amount of any desired medicine, and this, too, in the purest and most active state of the medicine. The reverse of this phenomenon is also of interest. It is found that by cataphoric demedication medicines like, for instance, arsenica and mercury, may be removed from the patient, and be visibly deposited upon the negative electrode, according to the usual rules of electro plating. A curious feature of electrical application is the different effect of different currents on the respective fibers of which the human body is composed. For instance, striped muscular fiber constitutes the bulk of the human body, and, while it contracts to an alternating current, it does not contract to a continuous current. On the other hand, the smooth muscular fibers which make up the heart, the uterus, and other important organs, and exist in the intestinal walls, contract powerfully to a continuous current, but are not so readily affected by an alternating current. This distinction leads to a very important differentiation in electro-therapeutics, and one which is scarcely yet recognized in practice. An illustration of this is afforded in cases of occlusion and paralysis of the bowels, in which intestinal movements will be best set up by a continuous current, which would not cause a contraction of the biceps or other muscle composed of striped muscular fiber. This law of electrical selection is also displayed to a marked extent in electro-diagnosis. Where muscle degeneration is suspected, if the faradic or induced current is turned on, it will be found that the muscle, if degenerated, has lost in a greater or less degree its power of contracting, simply because in its changed condition no single electric impulse lasts long enough to affect it. If the galvanic or continuous current is turned on, the muscle contracts to single impulses, because they last longer; but the singular fact is brought out that, whereas in the healthy muscle the negative pole causes the greatest contraction, in the diseased muscle the maximum contraction is caused by the positive pole. This law, which is called the Reaction of Degeneration of Erb, is the physician's great reliance for prognosis or diagnosis in many most serious diseases of the nervous and muscular systems. No general fact associated with the administration of electricity is more familiar than that the general health—the nutritional processes—are promptly and greatly improved. The exchanges between the blood and the tissues are augmented, the patient absorbs more oxygen and excretes more carbonic acid and urea, and he gains in weight and comfort. Dr. Morton pointed out the enormous power, in these and many other ways, possessed by electricity over some of the functions of the living tissue. In fact, as he put it, the trouble is, not that electricity does so little in our human bodies, but that it does so much, and in utilizing it in the interweavings of tissue the electro-therapeutist pauses, bewildered with the problems of biology and the processes of disease. In discussing the physiological effects of the Tesla, Morton and D'Arsonval currents, the lecturer spoke of the static induced current which he introduced into medical work in this country in 1881, and which has since borne his name. Of the capabilities of this current, some interesting illustrations were given by means of the influence machine. Dr. Morton concluded what will be a memorable lecture in the history of the New York Electrical society by asking electricians to join hands with the medical profession in turning electricity to the amelioration of the ills and sufferings of humanity.

Projected African Telegraph Line.

Capital to the extent of $700,000 has been subscribed for building the telegraph line from the Cape of Good Hope, Africa, to Cairo, Egypt, which is considered sufficient to carry the line as far as Uganda. The materials are now being ordered in London, and will be shipped shortly. The poles are to be of iron of light construction, in order to outmanœuvre the white ants, which would eat away wooden poles. From Fort Salisbury the line is to be carried to Tete, on the Zambesi, and from thence to Balantyre. There Consul Johnston will report the result of his surveys as to the best manner of proceeding on to Uganda, and the constructing party will have to come to terms with the natives and Arabs by subsidizing the chiefs and others of influence. There are two alternative routes for the conveyance of the materials. There is good transport from the Transvaal to Fort Salisbury, or a shorter route would be adopted if materials were shipped direct to Bejra, carried along the railway now being built as far as it extends, and then conveyed the rest of the distance by ox-wagons. The scheme is being pushed forward with great activity.

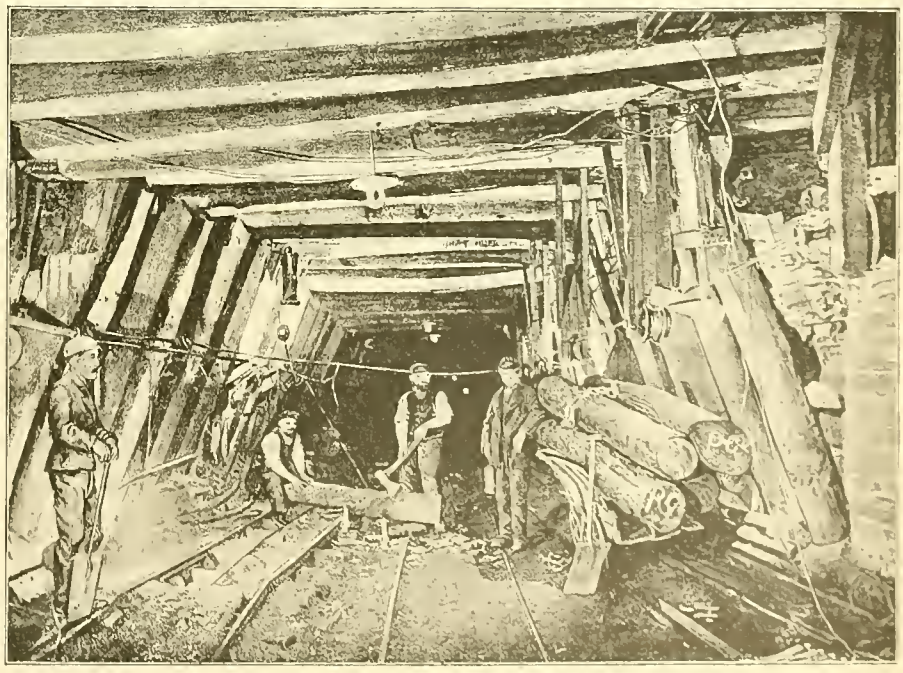

FIG. 4. ELECTRICITY IN A WELSH MINE.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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VISITORS

To the World's Fair are requested to forward their addresses to the WESTERN ELECTRICIAN as early as possible or notify us immediately upon their arrival in Chicago.

THAT was a queer application of electricity shown in Ottawa, Ont., a few months ago, when electricity generated by water power was used to produce steam in an electrically heated boiler, the steam thus generated being utilized in driving an engine. This is on a par with the transmission scheme at the World's Fair where water is taken from a tank by an electric pump and forced through a pipe to operate a water wheel, which in turn drives a dynamo to generate electricity of another phase. Neither of these demonstrations are designed to illustrate commercial possibilities, but both show the wonderful adaptability of electricity.

ANNOUNCEMENT is made this week of the appointment of the governmental delegates to the World's Congress of Electricians. The selection of Profs. Rowland, Mendenhall, Carhart, Thomson and Nichols to represent this country will be generally approved by the fraternity. They are men of reputation in the profession, and no doubt they will reflect credit upon this country by their contributions to the congress. It is also announced that W. H. Preece, Profs. S. P. Thompson and W. E. Ayrton, Major Cardew and Alexander Siemens have been named as representatives of Great Britain. These gentlemen are well known by reputation at least in this country and they will be heartily welcomed by American engineers.

THERE is certainly a divison of public sentiment on the question of opening the World's Fair on Sunday; everybody is in favor of evening opening. The exposition has not yet been opened to the public on the first day of the week, but several evening sessions have been given, and have proved very successful. Why, then, now that the electric lighting plant is so near completion, do not the directors at once abrogate the present clumsy evening closing rule and declare in favor of an open fair every evening? This step would be at once sensible and popular. The evening and Sunday opening questions are entirely distinct, and should not be confounded by any managerial juggling.

ATTENTION is called to the WESTERN ELECTRICIAN headquarters at the World's Fair, the address of which is published at the head of this page. To those unacquainted with the division of space in the electricity building it may be explained that "Y–32" indicates a space in the northwestern portion of the gallery of the building, on the aisle overlooking, from the east, the light well in that portion of the edifice. The diagram published in the issue of May 6th will serve to give a more exact idea of the location, although it must be observed that a change has been made since the list of exhibitors' spaces then published was prepared, by which the allottment to this journal was changed from Y–31 to Y–32. Here the friends of the WESTERN ELECTRICIAN who visit the World's Fair will always be greeted with a cordial welcome, and any information desired in relation to the electrical features of the exposition will be gladly furnished.

THE Patent Office should be above suspicion, but the revelations of the last few months have tended to weaken the faith which has generally been reposed in that department. Charges have been made against a former commissioner of patents and the attorneys of the Bell company for alleged irregular practices in connection with the issuance of several telephone patents. It is claimed that the commissioner caused certain applications to be copied for his own private use and for the Bell Telephone company. Chief Clerk Bennett of the Patent Office does not deny making the copies for ex-Commissioner Simonds. He says he was merely acting under orders and that in his position he could do nothing else but obey. The proceedings in the telephone controversy should be subjected to a thorough and critical examination. The present trouble may lead to a thorough reorganization and a much needed reform in the patent office.

NEGOTIATIONS between the rapid transit commissioners and the Manhattan Railway company of New York have been temporarily suspended. The company has refused to agree to the extension of the elevated system as proposed by the commissioners. It realizes that it is master of the situation and it evidently intends to wait for the commissioners to come to its terms. Already there are signs of uneasiness on the part of many who fear that further negotiations with the Manhattan company may be impossible. The straits to which the people are pressed is shown by the fact that many of those who have heretofore bitterly opposed the L scheme are now ready to turn over to the company at its own terms the most desirable streets and boulevards of the city. The necessity of increased means of travel between the upper and lower parts of the city is recognized. The city wants better service, and while its pressing needs may be temporarily filled by the proposed L system, it should not be expected that anything like permanent relief will be afforded.

THE election of Prof. E. J. Houston to the position of president of the American Institute of Electrical Engineers was a fitting recognition of the valuable work which that gentleman has done in the interest of electrical science. Prof. Houston's name is familiar to everybody acquainted with the development of the electrical industry in this country, although he has really had no connection with the commercial side and has been content to follow his experimental work and study at his own convenience. His excellent work in the early days of the electric light was enough to ensure his reputation and his more recent work as an author and instructer has added to his fame and given him a much greater following. During the next year the Institute hopes to add many new names to the list of members, and it has been suggested that meetings be held upon the Pacific Coast in the near future. It would certainly be gratifying to know that the electrical interests of that section had advanced sufficiently to warrant such a step. Of course a great deal of work has been done and much is in progress at the present time, while the future is bright with promise. At the present time the Institute has several members who are engaged, temporarily at least, upon the coast and they would no doubt do much toward securing new members if there were an opportunity for having a gathering occasionally.

RAILWAY telegraphers are still engaged in disputes over wages, hours of labor and other points, on many roads, and much uncertainty and uneasiness in business circles has resulted from this protracted agitation. It would appear that the organization which is supposed to represent the railway telegraphers of the country is under control of professional agitators. This organization formerly pronounced against strikes and under its conservative policy would have nothing to do with them, but the men in control to-day have departed from this course. Last week a strike was threatened at Chicago because an operator was discharged for insubordination and the cry was raised that the "order" was being attacked. The operator had been instructed to explain certain duties to a novice and he refused to obey. His discharge was followed by visits from grand chiefs and committees and a strike was threatened. It is certainly to be regretted that such an intelligent lot of men as those that compose the telegraphers of the country can be dominated by a few professional agitators, and be held up to ridicule before the world.

RECENT experiments in reducing the time of making a trip between Chicago and New York have developed the fact that with improved road beds, reduced curves and grades and improved machinery the running time can be materially lessened. Big railroad companies are taking advantage of these experiments. The cause of all this experimentiog and the willingness of railroad companies to put on faster trains is not due entirely to competition among themselves, nor any special demand by the public for these flyers. It is suggested that great strides made in the telephone business have stimulated railway men since the use of telephone for the last three or four years has somewhat cut off business travel on railways. It is possible for a board of directors, part of whom live in Philadelphia and a part in New York, to hold its meeting by telephone, and one of the courts has decided such meetings to be legal. Since the long-distance telephone system has made it possible for New York and Chicago to communicate as easily as in a personal interview it has been noticed by the railway managers that there has been some decrease in business travel between the two cities. It seemed to be necessary, therefore, for the railways to maintain themselves against this extraordinary and unexpected competition, and it is partly on account of the facilities which telephoning affords that these fast trains have been added.

IN a brief comment on the congratulatory dispatch sent by Mr. Preece, on behalf of the electrical engineers of England, to Prof. Elisha Gray on the occasion of the opening of the World's Fair, the *Electrician* of London says:

Whatever views may be held as to the utility of English firms exhibiting at Chicago, or whatever other opinions may be held about the exhibition, this expression of friendly congratulation may be taken as representing English appreciation of the energy which has carried the enterprise through, notwithstanding many adverse circumstances and a general lack of enthusiasm outside the United States.

The complimentary portion of this paragraph will be appreciated, but when our contemporary speaks of "a general lack of enthusiasm outside the United States" it evidently jumps to the conclusion that the whole world is indifferent to the exposition because it can discern no great manifestation of interest within the narrow confines of the island of Great Britain. The fact is that Germany and France have never before exhibited so much interest in an international exhibition held beyond the borders of their respective domains. In vying with each other to make the most impressive foreign exhibit, each of these countries has spent millions of dollars and they will send over many thousands of visitors. Austria-Hungary, Russia, Belgium, Holland, Italy and Spain are also creditably represented in nearly all the departments, while very extensive displays are made by Japan and New South Wales. Canada, China, Ceylon, India, Persia, Turkey, Egypt, Mexico and Brazil are all represented. In short, there is hardly a civilized or uncivilized country on the globe that is not interested, more or less, in the World's Columbian Exposition. Great Britain is not adequately represented, and this is particularly true in the department of electricity, where its small exhibit is completely overshadowed by both France and Germany. But this is no reason for asserting that there is a lack of foreign enthusiasm over the fair, which is far from the truth.

Practical Applications of Electric Heating.

As has frequently been pointed out in these columns, electric heating has occupied much more attention in Canada than in the United States, so far, at least, as its application to every-day uses are concerned. Recent advances are shown in several installations which are herewith illustrated. The first of these, Fig. 1, shows an arrangement for heating a conservatory in Ottawa. The furnace was placed in the basement, the controlling switches on the floor above, and all connected with the 50 volt lighting circuit. Three hundred feet of pipe was employed in the

FIG. 1. PRACTICAL APPLICATIONS OF ELECTRIC HEATING.

conservatory and the current absorbed was about 3 horse power. The amount charged by the local company was based upon the cost of an equal amount of power from a motor circuit. The plant has worked continuously without attention since last October. The second installation, illustrated in Fig. 2, was made in a drug store in the same city. The premises were piped throughout for hot water heating last November and the electric furnace was placed in the basement. This 50 volt furnace was constructed in five independent heaters radially connected to a common supply pipe. Each heater was independent of its neighbor, the five sections being connected in multiple both mechanically and electrically. Each section was controlled by five ten ampere switches, which were placed in a row in the store above, so that for all conditions of weather the heat could be regulated by turning off or on any of the five

FIG. 2. PRACTICAL APPLICATIONS OF ELECTRIC HEATING.

sections into which the furnace was divided. Another important consideration which suggested this design was that in the event of trouble with any of the five sections comprising the complete furnace, it could be detached by closing the valves, and the particular section which might require examination could be removed without disturbing the others. Despite the fact that last winter was unusually severe, this outfit worked without a hitch and without attention of any kind, and provided at all times the heat desired. For the usual Christmas display of the Chaudiere Electric Light company an electric upright boiler, Fig. 3, was designed which operated a one horse power engine, both the engine and boiler being placed upon a large table in the company's office. The boiler was provided with steam gauge, water glass and safety valve. Being nickel plated throughout, it presented a very handsome appearance. The safety valve was set for 35 pounds pressure, which operated the engine. As heretofore steam engines have been employed in applying the power necessary to energize dynamos, the novelty of this outfit consisted in the fact that the electricity was developed by water power, which was converted into heat making steam in the boiler, and which was then used in driving the steam engine.

In these installations the Ahearn electric heater was the type employed. The principle and details of construction of these heaters have been fully described in this journal.

Pentz-Reckenzaun Electric Meter.

In the accompanying cuts the details of the new Pentz-Reckenzaun electric meter are illustrated. James A. Pentz and Anthony Reckenzaun, the inventors, have given much attention to the elimination of faults that have hitherto been considered inherent in such meters. In this meter there are no springs, no loose hanging pendulums, no clock-work arrangements, no escapements, and owing to the force of gravity being utilized for actuating the oscillating bars, it is claimed that it is a perfect time-keeper.

The replacement of escapement spring clocks by electro-gravity synchronized pendulums, the double pendulums, metal case and slate base, and the exemption of the clocks

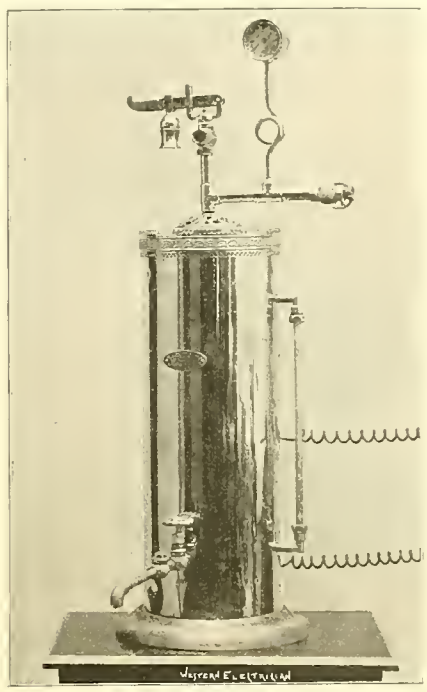
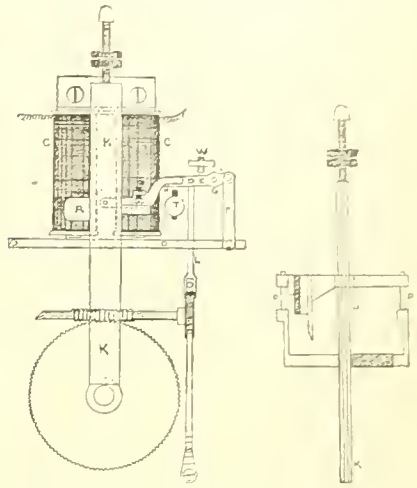


FIG 3. PRACTICAL APPLICATIONS OF ELECTRIC HEATING.

from driving any gear and reducing them to simple governors, their proper function, will rank as advances.

The new meter requires no attention in the way of winding, being driven by current taken from the supply. The cost of maintenance and driving should be small. An extremely low current is used in the driving magnets, somewhere about one-sixtieth of an ampere. The recorded value can be given directly in units. The permanent magnet meter is, of course, restricted in its employment to direct current circuits, but a similar adaptation is in view to make the meter of use for alternate current work.

The mechanism in the meter may be considered under three heads: First, the standard metronome; second, the electrically influenced pendulum and its gear; third, the recording and indicating apparatus. The electro-magnetic driving apparatus and the pendulum bar of one side of the meter are shown in Fig. 1, while the side view of the pendulum is given in Fig. 2. Fig. 3 shows the connections of the meter in a circuit, and introduces the relay which closes the driving circuit when the meter is in action. When a current circulates in the main coil owing to a demand on the consumer's premises, the magnetic needle of the relay is deflected, closing the driving circuit and starting the pendulums. As the arrangement of both pendulums is electrically similar, it will only be necessary to trace the course of the current in Fig. 1, which represents half of the mechanism, to understand the action of the meter. The bar A' is insulated from the frame, and is connected to one end of the electro-magnet coil C. The other end of the coil C is taken to the negative side of the lamp circuit, through a resistance of 5,000 ohms, and the potential terminal on the right hand side of the principal terminal, which is connected to the other side of the circuit by a small, well insulated wire. The positive side of the circuit is made through the relay to the frame of the magnets, and thereby the contact screw enables the current to flow to the pendulum bar, thence through the coils and the route described. At the moment the current is turned on, the armature D will be attracted, and consequently the pin H, on the lever K, will fall, permitting the full weight of the gravity piece J to drop upon the cross piece K, which is a lateral extension of K', and thus the latter is started into vibration. When the end of



FIGS. 1 AND 2. PENTZ RECKENZAUN ELECTRIC METER.

the gravity piece strikes the stop T, the driving circuit is broken by R, leaving the screw S; the armature D therefore, immediately falls, and in so doing resets the pin H to its first position, being limited in its upward movement by the stop screw W. On the pendulum swinging back, the cycle of operations is again repeated, and this continues so long as the relay needle is deflected by current passing through the main coil. The driving power of the metronomic system is, therefore, obtained by the force of gravity, which acts upon a definite mass free to fall a given distacce, and is, therefore, independent of the variation in driving current due to fluctuations in the voltage in the mains. The registration is effected by causing the dependent catch bar L to actuate the ratchet wheel shown on Fig. 1, so that for every complete swing of the bar K' a tooth in the wheel is moved forward and the swing registered upon the recording apparatus.

The arbor of one clock being hollow allows the arbor of

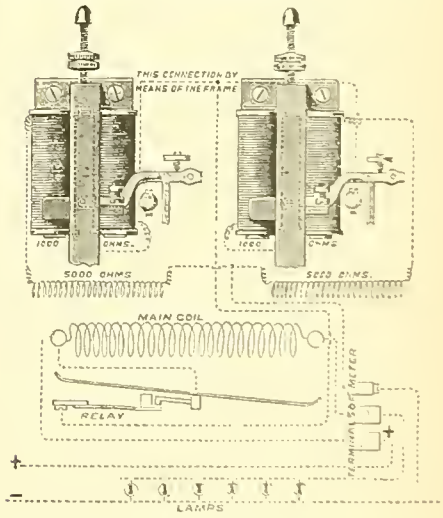


FIG. 3. PENTZ RECKENZAUN ELECTRIC METER.

the other one to be brought through it. The former carries the dials on a frame, the latter a wheel which gears into one on the frame, so that if the two axles revolve together the relative position of a pointer fixed to the wheel carried by the frame and a point on the dial itself is unaltered. When, however, one axle is given a higher rate than the other, the difference is indicated by a displacement of the pointer, and by suitable counting gear the registration of consumption is effected.

Such sparking as might occur with the small current broken periodically at S has been practically eliminated by a special compound winding of the magnet coils. The bar R and screw S are at different radii from centre of

vibration of K, so that a rubbing contact is insured in preference to merely the butt contact which might foul slightly after a period of use under practical conditions. The main coil, through which passes the current to be measured, is a solenoid of special shape and very low resistance. It is placed with its center below the point of suspension of the magnetic pendulum, whose rate of vibration it accelerates positively by virtually increasing the effect of gravity upon the bar. The relay needle underneath the main coil is deflected by less than the current required by one lamp,

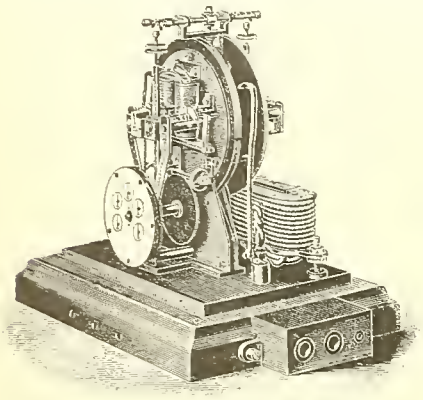


FIG. 4. PENTZ-RECKENZAUN ELECTRIC METER.

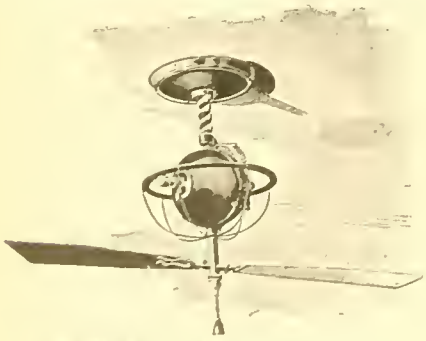
and so starts the clocks, which cease to register when the current is switched off.

The adjustments are threefold, the first and second being only attempted by the makers, while the third is open to the meter testers of supply companies. For synchroniz'ng the two bars and timing their vibratory beats two nuts are arranged on screwed extensions of the pendulums, while the fine adjustment is given by slight variation in height of contact screw S. These two means enable meters to be calibrated so as to start registering without difficulty, maintain straight line curves, and read directly in units.

If, however, the standards of makers and consumers vary, a final adjustment can be made by raising or lowering the main coil, which is mounted on screwed legs with leveling and back nuts for this purpose. There can be no tampering when the metor has been passed for service, as two covers are used, the first covering up the mechanism and being sealed by the local inspector, while the second contains the three terminals only, the access to which would be open to the central station company, but sealed by it to prevent unauthorized interference. The case of the meter is of japanned metal, fitting air-tight to the base. The parts are mounted on a slate base set within a cast metal frame for strength, while the supporting framework of the parts is utilized as magnetic shields, screening the driving gear of the clocks from one another and from the magnetic pendulum which is given every surrounding possible to ensure accuracy. These meters are manufactured by the Pentz-Reckenzaun Electric company, 1001 Chestnut street, Philadelphia, Pa.

The Lundell Ceiling Fan Motor Outfit.

The accompanying illustration shows an ingenious combination of a big two blade fan and a small compact motor. The device is so constructed as to depend from



LUNDELL CEILING FAN MOTOR OUTFIT.

any ceiling at the correct distance for the required effect. The blades of the fan are constructed of hard wood, and the pitch of them can be changed to suit requirements by loosing the screws which hold them in position and resetting them.

The method of transforming the motion of the commutator shaft of the motor into a motion at right angles to it is worked out so cleverly as to obtain an absolutely noiseless result at maximum speed. Upon one end of the motor shaft a small friction wheel is attached. Encircling the motor and resting on this wheel is a thin circular ring plate which receives its motion by friction from the small wheel. This circular ring plate is in turn connected with the fan shaft by four curved metal braces, making a solid and strong construction.

The relation of the speed of the fan to that of the motor thus becomes as one to eight. To operate this outfit only six tenths of an ampere of current is required, or about the same amount as is required for an ordinary 16 candle power lamp. The motor is the invention of Robert Lundell, and the outfit is placed on the market by the Interior Conduit & Insulation company, New York.

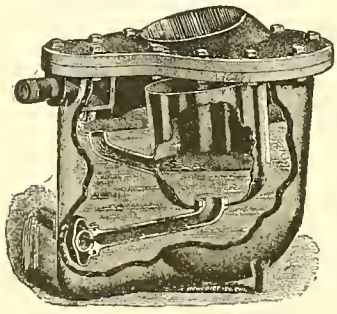
Fidelity Steam Trap.

The accompanying cut represents the Fidelity steam trap, manufactured by the Van Auken Steam Specialty company of Chicago. This trap is made especially for high pressure and heavy duty. All parts are made extra heavy, and its proportions are such that it will stand any pressure carried on steam apparatus. High pressure does not retard its operation. It is provided with an open float, to which is attached the hollow valve arm, ground to fit the outlet plug. It continues to wear its own seat and remains tight, hence it never needs grinding. Its main features are that it has no closed float to collapse or fill up or complicated valves that are liable to stick. The action is positive under all conditions, and the valve opens to such an extent that it discharges the condensation in the same volume as it enters the trap.

These traps, which are now used at the Adams street station of the Chicago Edison company, are designed to be used for draining the condensation from heating systems, steam separators, dry-kilns, evaporating pans, etc., and they are said to work on pressures as high as 150 pounds.

Elliott Car Brake.

The brake invented by G. R. Elliott of Boston, Mass., a cut of which is here presented, is the embodiment of simplicity and efficiency, and is constructed on mechanical principles unerring in their operation and positive in their results.

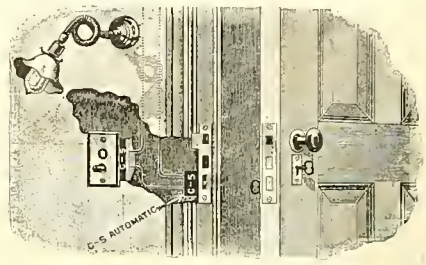


FIDELITY STEAM TRAP.

A chilled iron cylinder having a screw thread cut upon its surface is firmly fixed upon the axle of one pair of wheels of the truck of a car; a like cylinder, of smaller dimensions, is hung in bearings at the lower end of a lever frame in such a manner as to bring it parallel to that upon the axle. The fulcrum of this lever frame is an iron rod having loose bearings in the woodwork of the truck frame, and with this rod the lever frame carrying the smaller screw cylinder reciprocates.

To the the uper end of the lever frame is attached the rod leading to the brake handle, which rod is divided, and has a spiral spring interposed at the junction in such a manner as to make the pull of the brake elastic. A half turn of the brake handle draws this rod forward, causing the lower part of the lever frame, which bears the small screw cylinder, to move toward the larger screw cylinder fixed upon the axle of the wheels with which it engages, and by which it and the lever frame carrying it are moved toward one one side or the other of the car, according to the direction in which the latter is moving. A link-arm, one end of which is attached to the lever frame and which, moving with it, is connected by its other end to the end of one arm of a three-armed rocking lever, fulcrumed at the junction of its three arms and operating in such a manner that whichever direction the lever frame takes, by reason of its small screw cylinder engaging with the screw cylinder on the axle, the three-armed rocking lever will be moved so as to cause one of two links connecting two of its arms to an ordinary straight lever at one end of the truck frame, to draw inward, thus causing the other end of the last mentioned lever to move outward, carrying with it the rod connecting it with the beams of the brake shoes, and thus bringing the brake shoes against the thread of the wheels against the stress of springs, which withdraw the shoes the instant the brake handle is released.

A very slight turn of the brake handle will bring the screw cylinders into engagement, and the smaller cylinder will immediately begin to move in a direction at right angles to the length of the car, and parallel to the axis of the axle upon which the fixed screw cylinder is located, and it will continue to move in this direction until the strain upon the brakes exceeds the pressure exerted upon the brake handle, when it will disengage and fly back toward its former position; engaging again instantly, the excessive pressure ceases, and repeating this action until the car stops. This is accomplished so rapidly that the

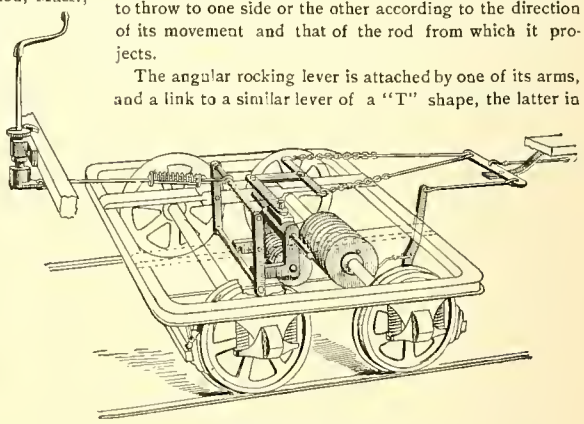


A NOVEL APPLICATION OF THE "C-S" FLUSH AUTOMATIC SWITCH.

effect upon the car is the same as would result from a continuous pressure of the brake shoes against the wheels, yet the several pressures have the effect of destroying the sudden jerk resulting from the locking of the wheels, and while avoiding the friction and consequent flattening of the peripheries of the latter, is none the less effectual in bringing the car to a stop.

In one end of the rod forming the fulcrum of the lever frame carrying the small screw cylinder is fixed a pin which reciprocates with the rod and causes an angular three armed rocking lever in the crotch of which it plays to throw to one side or the other according to the direction of its movement and that of the rod from which it projects.

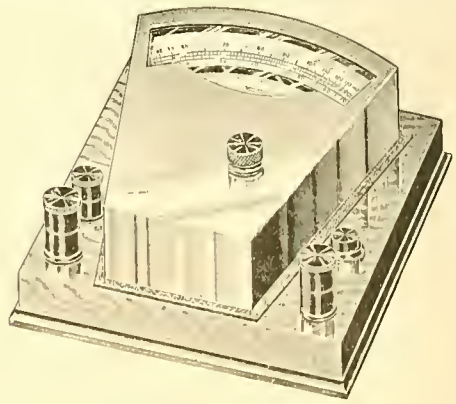
The angular rocking lever is attached by one of its arms, and a link to a similar lever of a "T" shape, the latter in



ELLIOTT CAR BRAKE.

turn operating an arm arranged above a rheostat. The rheostat also has an arm, against one side of which the last mentioned arm is pressed when going in the direction to cut off the current when the brakes are put on; but when the brakes are released the rheostat arm is left turned so that the motorman must by the ordinary means within his control turn on the current to start.

It will thus be seen that while putting on the brakes



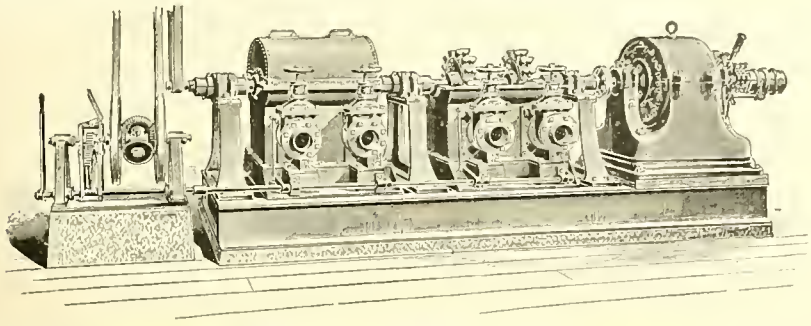
NEW WHITNEY ALTERNATING CURRENT INSTRUMENTS.

turns off the current, throwing off the brakes does not turn on the current, but leaves the car at a standstill until the motor man chooses to start it, when the brakes are in position not to retard its progress. Considering the fact that the greatest power necessary under any circumstances only requires that the brake handle be turned one-half of a revolution, it is clear that the action of the brakes is almost

if not quite instantaneous and that its lack of the rigid characteristics of the ordinary brakes makes the wear upon the wheels uniform, thus prolonging their life and usefulness.

Electricity In Mining Operations.

The accompanying cut shows an application of Pelton wheels to electric generators by direct connection to armature shaft. The wheels, four in number, are mounted on one shaft and connected to the generator shaft by an insulated coupling. They are 21 inches in diameter and have a combined capacity of 250 horse power, with a speed of 860 revolutions, under a running head of 340 feet. The



ELECTRICITY IN MINING OPERATIONS.

power from the station is carried thirteen miles and is used for general mining purposes.

The application here shown illustrates the extreme flexibility of the Pelton power system, and the facility with which adaptation can be made to all varying conditions.

The Pelton differential automatic governor, as shown on the left of the cut, insures absolute control, it is claimed, maintaining a uniform speed on the wheel, with instant and wide variations of load, and affords reliable means of of operating electric machinery by water power with a security and satisfaction.

A Novel Application of the "C-S" Flush Automatic Switch.

The accompanying cut shows a novel application of the "C-S" switch, described in a recent issue of the WESTERN ELECTRICIAN, in which it is so arranged that it will arbitrarily cut out the current from a hotel room by the process of locking the door from the outside.

As is shown in the cut the switch is placed in the moulding of the door jamb, immediately back of the striker plate, in such a manner that the push of the switch is directly in line with the movement of the bolt that is operated from the outside of the door. With this arrangement, when in the process of locking the door from the outside, the bolt is thrown, it engages with the switch push, thus opening the switch and turning off the lights, while locking the door from the inside has no effect whatever upon the action of the switch.

To provide means whereby the occupant of the room may turn the light off from the inside when desired, an auxiliary switch is placed on the inside of the room, in circuit between the controlling door lock switch and the lamps, in such manner that while the door remains unlocked upon the outside, the lamps may be turned on or off at will in the usual manner; but, whatever the position of this auxiliary switch may be, when the occupant locks his door from the outside upon leaving the room, the lights are invariably turned off.

This unique device is manufactured by the Cutter Electrical & Manufacturing company of Philadelphia.

New Whitney Alternating Current Instruments.

The Electric Appliance company, Chicago, is much elated over the success of the new Whitney instruments for alternating work. The alternating current voltmeter is an instrument with an almost uniformly divided scale, guaranteed absolutely accurate for the most careful measurements on any alternating current, being unaffected by variations in frequency. The Whitney instruments can be used on any kind of an alternating circuit or machine without in the least affecting the reading.

The uniform divisions of the scale is another point to which particular importance must be attached. Improvements in this respect are being continually made, and the voltmeter scales as now divided are even more uniform than shown in the accompanying cut. The 0 to 75 scales read from 15 to 20 in one-volt divisions and from 20 to 75 in half-volt divisions. The 0 to 150 scales read from 30 to 40 in two-volt divisions and from 40 to 150 in one-volt divisions. The double scale instrument combines both of these scales and reads in the same way.

The Whitney company has also met with success with its ammeter. Heretofore it has been almost impossible to make accurate quantity measurements of the alternating current without the use of a dynamometer requiring elaborate laboratory manipulation and considerable mathematical computation. This company is now supplying its agents and the trade and securing splendid results with an alternating ammeter guaranteed to be absolutely accurate and satisfactory, readable as low as one twentieth of an ampere in the small sizes with correspondingly small divisions for the larger capacities.

The Electric Appliance company is the general western agent for all of the Whitney products.

The Hawley Down Draft Furnace.

On account of the rigid smoke ordinances in Chicago and other western towns, the importance of equipping

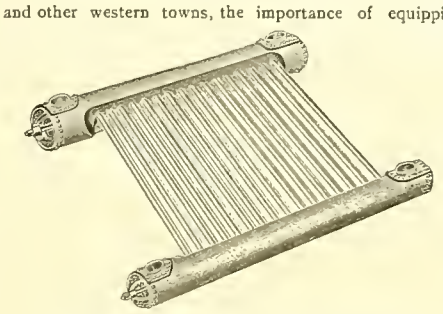


FIG. 2. HAWLEY DOWN DRAFT FURNACE.

steam plants with thorough smoke-consuming devices has been brought into prominence. In the East this important question has not received its share of attention, from the fact that anthracite coal is so largely used for commercial purposes; and wherever the smoke has occasionally proved offensive, some such appliance as a steam jet has been employed without regard to the small extra cost.

The accompanying illustrations show the operation of the Hawley furnace, as applied to a tubular boiler of the ordinary type. The upper grate, upon which the fuel is thrown, is formed of a series of tubes, opening at both ends into steel drums or heaters, which are connected by pipes to the boiler and through which, also, a constant circulation of water passes. By this arrangement the equivalent of a small water-tube boiler is added to the plant, and placed in the hottest part of the flame, thus greatly adding to its efficiency. A strong down draft carries the fuel through to the lower grating when partly consumed, and here it completes the combustion with an up draft, which thoroughly consumes all gasses and particles of carbon.

Thus the down draft system has two special features of very great advantage—a perfect combustion, which permits of the use of the poorest kinds of slack and refuse fuel with a very high efficiency, and an addition to the boiler in the water-tube grate, which increases both the economy and the capacity of the plant by almost fifty per cent.

No steam jets or other mechanical devices are employed, for they are unnecessary and only waste a portion of fuel already consumed. The saving in a short time from the use of the down draft furnace is enormous. Aside from the all-important feature of being absolutely smokeless, the saving in fuel is so great that in most cases the original outlay is paid for in the course of a year; in several instances in an even shorter time, by the greatly increased economy and efficiency obtained.

It is claimed for this furnace that it will burn any quality of coal with a consumption of ninety-five per cent. of smoke under all circumstances. From thirty to forty-five pounds of coal may be burned per hour over each square foot of grate surface with an evaporation of more than ten per cent. more water per pound of coal than is usually obtained. A uniform temperature of over 2,500 degrees Fahrenheit is reached in every part of the heating surfaces. With this furnace it is an easy matter to keep the boiler clean, since all impurities are quickly ejected from the steel drums at the end of the upper grate bars.

For electrical work, where sudden and heavy demands are frequently made on the boilers, the down draft system is of especial advantage. It has been found in the Edison stations in Chicago and at the city water works and gas works to meet every exaction beside being entirely smokeless. Some recent tests at these places have given surprising results as regards economy.

In most of the large cities of the West this type of furnace has been extensively introduced by the Hawley Furnace company. The principal office is at 806 Security building, Chicago, under the management of Dion Geraldine, late city engineer. Ellis Wainwright is president.

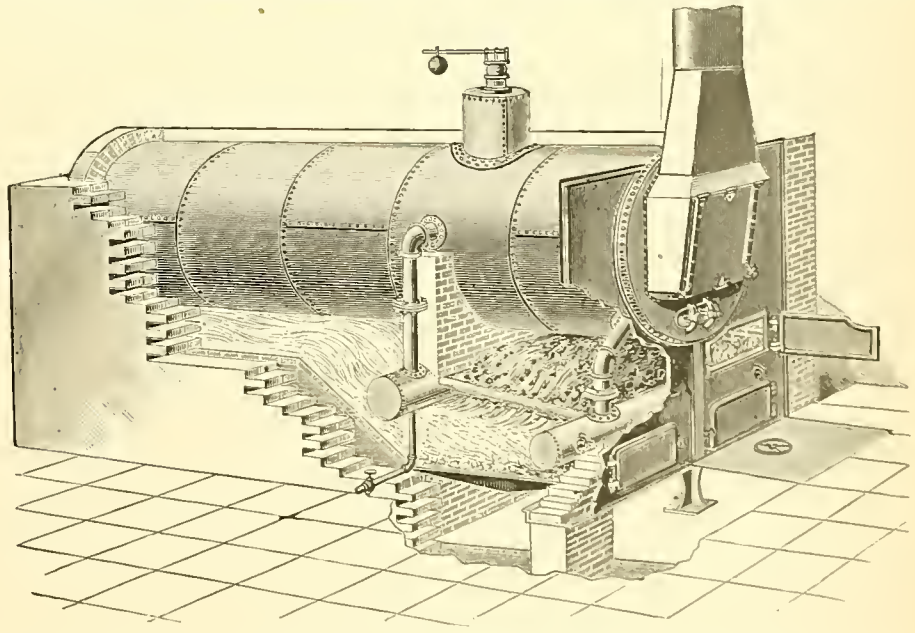


FIG. 1. HAWLEY DOWN DRAFT FURNACE.

It is rumored at Toledo, O., that the right of way has been secured into the heart of the city for an electric railway, which will connect Toledo and Detroit. There can be no doubt of the success of the scheme, as it is backed by two noted Michigan men, who are abundantly able to carry out the project—Senator James McMillan and Millionaire Joy. The line will strike Ohio just above Manhattan and will have its terminus at the junction of Oak and Summit streets. The capital stock will be about $600,000, and it is proposed to carry passengers between the two cities for $1.50, as compared with $2.60 by steam railroads.

A company is being formed at Chambersburg, Pa., for the purpose of putting in electric street railways on the main streets of the city; also to extend the road to Fayetteville and Green Village. It is said that capital to the amount of $500,000 has already been obtained for the new enterprise.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 20.—The attempt to secure rapid transit for New York is blocked again. The free comment which has been recently passed on the action of the Rapid Transit commissioners seems to have had the effect of arousing that body to a sense of responsibilities, and a disposition to bring to bear on the situation the judgment and firmness it demands has, alas, too late, begun to manifest itself. At the meeting the commissioners on the 15th Comptroller Myer advised the commission to adhere to the original demand in the matter of the extension of the Manhattan elevated railroad, namely, that the company pay to the city 5 per cent. of its net receipts, meaning the gross receipts, less operating expenses and taxes, as compensation for the privileges of extending its lines over the routes agreed upon. He insisted that it would not be fair to the city to accept 5 per cent., after taxes, operating expenses and interest on funded debt were deducted, and upheld the fairness to all concerned of the original demand. On the 17th inst. there was another meeting of the commission, at which these ideas were embodied in a letter to the Manhattan Railroad company. In a letter received to-day by the commission, George J. Gould, president of the Manhattan Railway company, announces that the directors cannot accept the terms proposed, and do not feel called upon to modify the suggestion made to the Rapid Transit commissioners in their letter of May 5th. The Manhattan company asked the commission not to tax the interest on its funded debt,—aggregating $40,000,000, which interest would be $2,000,000 per annum, but expressed its willingness to pay 5 per cent. tax to the city on its net income, provided the $2,000,000 was deducted therefrom. The remaining point at issue is the Kingsbridge extension to the city line. The Manhattan company refuses to make the extension until the city extends its growth in that direction. So there is a block, and the situation is pretty well defined in the words of one of the commissioners, who at the last meeting is reported to have said: "There is no question that now the Manhattan has us just where it wants us. This commission has played into the hands of that corporation. Just what I have been fighting against has happened. This, I maintain, is a sad day for rapid transit in New York city. It simply kills the whole matter." New York, suffering and helpless in the grip of corrupt and unscrupulous corporations, is a sorry sight in these enlightened days.

The general assignment of Erastus Wiman for the benefit of his creditors is said to have been caused by the recent excitement in Wall street. Mr. Wiman states that he had nearly effected an arrangement with the General Electric company, which would have relieved him of liability for the payment of $150,000, and would have provided the money necessary to complete the new plant of the electric lighting company at Livingstone, now almost finished. The condition of the money market led the General Electric company to withdraw, and Mr. Wiman, having separated himself from other sources of supply, was compelled, after consulting with the Boston banks, which held the company's notes, to apply for a receiver. The result, so far as Mr. Wiman is concerned, is that liabilities of $150,000, which he had good reason to believe would be extinguished, are in force, while assets, which have cost him in cash $200,000 practically sink out of sight. Thus a difference of $350,000 is made in his estate. It is understood that the negotiations had progressed so far that the General Electric company paid two weeks' pay rolls of the Staten Island company, and had three of its representatives elected upon the board of directors.

The phonograph bucket shop at 40 New street has been "pulled" by the police. It was a scheme for speculating on four mining stocks with marked prices made on the premises. The chief factor in the business was a big phonograph which recorded the "fluctuations" of the stocks already loaded on the cylinder, and whose records were taken down on the blackboards by two clerks. There were two parties in this interesting game. One was Rumble & Co., the power behind the phonograph; the other was the customer. The customer put down the money, and Rumble & Co., after a few turns of the phonograph cylinder, raked it in. The crop of gambling fools is surely never ending, or such a transparent fraud as this would deceive no one. As it was, however, Rumble & Co. did a roaring business, and felt greatly aggrieved at the officiousness of the authorities in putting a stop to their roguery.

News comes from Washington that formal charges have been filed against W. E. Simonds, the late commissioner of patents, and Foster & Freeman, the Washington attorneys for the Bell Telephone company, alleging improper inspection of the secret files in the Drawbaugh telephone cases, and the unlawful taking of copies thereof for the private use of Mr. Simonds and of the Bell telephone company. Chief Clerk Bennett of the Patent Office is also mentioned in the transaction. The charge is said to be indignantly disowned by Foster & Freeman. Mr. Bennett states that he furnished the copies, and would do so again, as a simple discharge of his duties, if he were called upon to do so. W. F. O.

Milwaukee, Wis.

MILWAUKEE, May 20.—A peculiar accident occured a few days ago at the power house of the West Side Railway company. The water main in front of the power house burst, filling the street with water. The submerged tracks and the impossibility of getting water for the boiler made it necessary to abandon the whole line. The break occured at 8 o'clock in the evening and it was 10 o'clock before the water could be turned off. Supt. Trapschuh, of the water distribution department, said that the accident was due to the eating of the pipe by electricity escaping from the main car cables. The cable ran parallel to the pipe and close to it. Similar accidents, Mr. Trapschuh said, had occurred in other cities where the main cables are close to the water mains, and he had been expecting such an accident in Milwaukee. The lead pipe connecting the main with the property directly opposite the power house has been destroyed by electricity three times during the past two years.

An important telephone decision has been rendered at Eau Claire. A. Jackson has sued the Wisconsin Telephone company to recover damages for the loss of a barn which had been destroyed by fire as a result of a bolt of lightning following one of the telephone wires which was strung over the roof of the barn. The jury disagreed the first time that the case was tried. It has just been tried again, the jury giving the plaintiff a verdict for $9,258.73.

The Common Council of Marshfield has awarded to the Marshfield Water, Electric Light & Power company a contract to light the city with electricity. Twenty-three lights are to be used and they will cost $1,800 a year. The company asked the council for a thirty year franchise, but even had the aldermen been disposed to grant such a franchise they would have been prevented by a law which the last Legislature passed.

An automatic switch-throwing device has been successfully tested on the lines of the Milwaukee Street Railway company. The device is the invention of Samuel Walker and Le Grand Marshall. Mr. Walker, seeing the necessity of something that would take the place of the old-time iron hook, conceived the idea of the device, which has been tested to the satisfaction of the street railway people. The part of the device attached to the car consists of a cam-post extending downward under the car, just in front of the life-guard. The cam-post is connected with the front platform by a handle, which is used to turn it either to the right or to the left, at the will of the motorman, and a pedal upon which the motorman, by pressing his foot, makes the cam post descend. The cam-post in descending comes in contact with two bars, one parallel and the other at an angle on the top of a cast-iron box placed between the rails. These bars, which slide from side to side, are connected with a lever which runs to the under side of the switch tongue, which is moved by the lever in obedience to the action of the cam-post upon the sliding bars. The long lever is protected by a heavy cast-iron covering, which shields it from dirt, snow and ice.

The Wauwatosa motor company has decided to equip its road with electricity. Contracts for furnishing the necessary power will be made with the Milwaukee Street Railway company and the company that now operates the street railway between the city and the village. As soon as the line is equipped with electricity the motor line will run cars through the city to the lake front, using the Becker line. In order to secure funds with which to make the improvement, the company has decided to issue bonds to the sum of $100,000, payable in gold at the end of ten years and bearing interest at the rate of 6 per cent. Half of the sum, it is said, has been subscribed. It is expected to build and equip the North Greenfield extension and to equip the present system by early summer.

The Menasha & Neenah street railway has been sold to F. S. Shoemaker, president of the American Cereal company of Akron, O. Mr. Shoemaker will visit the Twin Cities in a short time and make arrangements for equipping the line with electricity.

J. M. Duane and J. R. Davis, of New York, spent a week or ten days in the city recently, looking over the Villard electric railway interests. They represent a syndicate of New York capitalists that is negotiating for an interest in the Milwaukee street railway system. Messrs. Duane and Davis examined the various lines, the power houses, shops, etc., and it is said that the syndicate which they represent will take a large interest in the property. There is a suspicion that perhaps Villard is getting ready to part with some of his Milwaukee holdings. Recently it was announced that the North American company's holdings of between $4,000,000 and $5 000,000 of the bonds of the Milwaukee Street Railway company would be placed on the market, and it is possible that Messrs. Duane and Davis represent prospective purchasers of these bonds.

The Common Council has made some progress in the matter of street railway legislation. The ordinance requiring motormen to sound their gongs when their cars approach street crossings has been favorably acted upon. At a recent meeting of the aldermen the judiciary committee recommended that the ordinance be placed on file. In damage suits, it was stated, the company set up the claim that no law required the motormen to sound the gongs at street crossings. The ordinance was re-referred and adopted at a subsequent meeting. The plan to require the street railway company to give checks good for another ride when delays or break-downs occur has been killed apparently. C.

New England Notes.

BOSTON, May 20.—The Milford & Hopedale Storage Battery Street Railway company is in trouble. The Brush Electric company and the Consolidated Electric Storage company have brought suit against the railway for alleged infringement of the patent granted C. F. Brush March 6, 1886.

The Marlboro, Mass., Electric Street Railway company has chosen officers as follows: President, E. R. Alley; treasurer, Thos. T. Robinson; director, S. H. Howe. A committee has been appointed to purchase land for a new car house and to extend the road to Southboro, if the permission of the authorities can be obtained.

Two heavy verdicts for damages have been granted against the West End Street Railway company and the Lynn & Boston Street Railway company. Frank M. Cavanagh sued for damages caused by a car suddenly being started up, which threw him to the ground and injured his leg so that it had to be amputated. He secured a verdict of $18,000. The suit against the Lynn & Boston company was based on much the same grounds, and a verdict of $17,000 was given by the jury.

Cambridge is discussing the plan of starting a municipal lighting plant. President Russell of the Common Council has introduced an order contemplating this enterprise.

A big electric web is to be woven around Brockton to connect it with Stoughton and the Bridgewaters. The Rockland & Abington company has awarded contracts for the building of a line to connect Rockland with Abington, Whitman and Brockton. The road will use an equipment of Westinghouse pattern. A car house 100 by 150 feet is to be erected near the Rockland line. The road will also in time be extended to the Weymouths, where it will connect with the Quincy & Boston road and thus connect Brockton with Boston. The formation of four other street railways has been effected as follows: Brockton & East Bridgewater, five miles; capital stock, $100,000; directors, Aaron Hobart, R. O. Harris, East Bridgewater; Alfred A. Glasier, George H. Campbell, Alston Burr, Boston; H. B. Rogers, John P. Morse, Brockton. East Bridgewater & Bridgewater, three miles; capital stock, $100,000; directors, James C. Leach, Hosea Kingman, Aaron Hobart, R. O. Harris, A. A. Glasier, G. H. Campbell and H. B. Rogers. Brockton & Bridgewater, six miles; capital stock, $200,000; directors, Hosea Kingman, J. C. Leach, A. A. Glasier, G. H. Campbell, Alston Burr, J. P. Morse and H. B. Rogers. Brockton & Stoughton, five miles; capital stock, $150,000; directors, Chas. Tenney and Geo. F. Walker, Stoughton; A. A. Glasier, G. H. Campbell, Alston Burr, J. P. Morse and H. B. Rogers. The capacity of the Brockton power station is being doubled to provide power for the proposed roads.

The Thomson-Houston Electric company has brought suit against the Winchester avenue and West Haven electric road in New Haven, Conn., for alleged infringement of the trolley patents. Damages are set at half a million dollars. A. C. Pond of Boston is president of the defendant corporation, and it is understood that he intends to fight the case to the last extreme. The statement is credited to an official of the New Haven road that the ground of the defense will be to attack the validity of the trolley patents by citing the fact that the trolley was used nearly a quarter of a century ago in telegraphing from moving trains.

J. C. E.

PERSONAL.

Cards are out announcing the marriage of Miss Idabel Blakeman to Henry G. Issertel of the A. B. C. company, New York.

NEW INCORPORATIONS.

Automatic Electric Railway Signal company, New York, N. Y.; capital stock, $3,000; to manufacture and sell automatic railway signals.

Woodstock Electric company, Woodstock, Vt.; capital stock, $22,000; to manufacture and sell electricity for light, heat and power purposes.

Franklinville Electric Light company, Franklinville, N. Y.; capital stock, $12,000; to manufacture and use electricity for light, heat and power.

Nazareth Electric Light & Power company, Nazareth, Pa.; capital stock, $10,000; supplying light, heat and power by means of electricity. G. W. Mackey, Bangor, Pa.

Pleasure Resort Railway company, Denver, Colo.; capital stock, $100,000; to build an electric street railway from Denver to resorts and places of amusement in or near the city.

Electric Developing & Supply company, St. Paul, Minn.; capital stock, $100,000; to manufacture and sell dynamos, motors, electrical machinery and supplies of every description; N. L. Hills, St. Paul, Minn.

Winchester Electric Light company, Winchester, Ill.; capital stock, $14,000; to establish and operate an electric light plant in Winchester, Scott county, Ill.; C. H. Condit, Winchester, Ill.

Beck-Watts Fixture company, Des Moines, Ia.; capital stock, $25,000; to manufacture, buy, sell and deal in fixtures of all kinds relating to gas, electricity, etc.; Hunn & Evans, Des Moines, Ia.

D'Unger Electrical Telephone Manufacturing company, Chicago, Ill.; capital stock, $100,000; to manufacture electrical telephones and other electrical appliances; H. S. Folger, 167 Dearborn street, Chicago, Ill.

Old York Road Passenger Railway company, Philadelphia, Pa.; capital stock, $15,000; constructing and operating an electric railway in Philadelphia; John A. Rigg, 8th and Dauphin streets, Philadelphia, Pa.

New Bedford & Fairhaven Traction company, Jersey City, N. J.; capital stock, $1,000,000; to construct and equip street railroads in New Bedford, Mass.; Waller, Cook & Wagner, 15 Wall street, New York, N. Y.

Western Electric Supply company, Des Moines, Ia.; capital stock, $25,000; to manufacture, buy, sell and deal in electric supplies, material, machinery, improvements and inventions; Hunn & Evans, Des Moines, Ia.

Metropolitan Electric Engineering company, Chicago, Ill.; capital stock, $50,000; to manufacture and sell all kinds of machinery, especially electrical motors; Rohde, Staab & Fleischer, 81 Dearborn street, Chicago, Ill.

Enterprise Manufacturing company, Hartford, Conn; capital stock, $125,000; to develop and sell water and electric power; to manufacture and sell goods and fabrics and other articles; Austin Brainard, Hartford, Conn.

West Jersey Traction company, Camden, N. J.; capital stock, $3,000,000; the formation of traction companies for the construction and operation of street railways or railroads, etc., Mitchell B. Perkins, Beverly, N. J.

Wyoming Electric Light & Power company, Peoria, Ill.; capital stock, $15,000; to maintain and operate electric light plant in Wyoming, Ill., and deal in electrical merchandise and apparatus; E. B Hillman & Co., Peoria, Ill.

Spring Valley Electric Light company, Peoria, Ill.; capital stock, $25,000; to maintain and operate electric light plant, and deal in electrical merchandise and apparatus in Spring Valley, Ill.; E. B. Hillman & Co., Peoria, Ill.

Lake View Water company, Redlands, Cal.; capital stock, $1,000,000; to deal in water and water rights, works, ditches, pipe lines, etc.; real and personal property; to maintain and operate heat and power houses for electricity, etc.; F. E. Brown, Redlands, Cal.

High Shoals company, Harden, N. C.; capital stock, $50,000; to manufacture cotton, wool, etc.; to generate electricity by water power, applying, transmitting and selling the same or the power produced thereby and to do general mercantile business; Paul Bigelow, Harden, N. C.

Lackawanna Valley Electric Light & Power company, Mayfield, Pa; capital stock, $150,000; furnishing light, heat and power by electricity to the public in Mayfield, Pa., and to such persons, partnerships and corporations residing therein or adjacent thereto, etc.; J. W. Aitken, Carbondale, Pa.

Strowger Farm Motor company, Chicago, Ill.; capital stock, $4,000,000; to manufacture and deal in farm electric motors, made to propel all kinds of farm machinery, and operate movable and fixed machinery; to deal in patent rights, etc.; A. L. Stone, Chamber of Commerce building, Chicago, Ill.

ELECTRIC LIGHTING.

The electric light plant at Winchester, Ill., was totally destroyed by fire a few days ago. The loss is estimated at $18,000.

The Board of City Trusts, of Philadelphia, has passed a resolution appropriating $75,000 for electric lights and power in Girard College.

The Electric Manufacturing company, of Rockford, Ill., is asking for a right of way for wires and poles with a view of furnishing commercial lighting.

The Jackson, Mich., Light & Power company has purchased the plant and franchises of the Jackson Edison Light company, and the consolidated enterprise will be known under the title of the General Electrical company.

ELECTRIC RAILWAYS.

An electric railway will be constructed at Michigan City, Ind., at a cost of $225,000.

Franchises have been granted at Atlanta, Ga., to the Lithia Spring Railway company, to construct 10 miles of electric street railway.

It is reported that the street railway at Guadalajara, Mexico, has been sold for $400,000 to Baltimore and Philadelphia capitalists.

The Allegheny Valley electric railway, to run from Parnassus, Pa., to New Kensington, Westmoreland county, with a capital of $15,000, has been chartered.

The citizens of Appleton, Neenah, Oshkosh and other cities in Wisconsin have under consideration an electric system, giving the Fox River valley an electric road from Green Bay to Oshkosh and Berlin.

The projectors of the Pittsburg, Neville Island & Coraopolis, Pa., electric railway expect to get the line in operation at no distant date. From McKees Rocks to the end of the line the road will cost $135,000.

An electric street railway line is being surveyed between Martinsville, Ind., and Indianapolis. The chief projectors of the line are H A. Smock, Oscar Matthews, E. F. Branch and John Hardinck, Martinsville, Ind.

The Ashton & Clarksville Electric Railway company, Ashton, Md., has been incorporated to build an electric railroad from Ashton to Clarksville, forming part of the proposed electric railroad from Baltimore to Washington.

The Chillicothe, O., Electric Railway & Lighting system and the Juneman electric light plant have been sold to a New York syndicate for $140,000. New tracks will be put down, a two-mile extension will be made and a number of new cars will be purchased.

A new underground electric railway has been planned for Berlin, Germany, proceeding from Weidendammer Thor to the Belle Alliance place. The distance is about two and one half miles, which the train will run in seven minutes—a high speed for an underground line.

The electric street railway company at Winnipeg, Manitoba, has submitted to the city council plans for approval of several extensions to its present system for the coming summer, and is also arranging for opening a park for summer amusements, situated at the extreme end of one of its branches.

It is proposed to build an electric line from Martinez to Oakland, Cal. The new road will begin at Martinez and will run direct to Walnut Creek, where the road will branch. One line will be built down the valley through Alamo and Danville to Doughterty's Station in Alameda county, and the terminus will be located at Haywards. The branch will go into Oakland will leave the main line at Walnut Creek, and will cross the Contra Costa foothills at a point near where the new Broadway grade is to be built.

TELEPHONE.

The Bell Telephone company has obtained an exclusive ten years' franchise at Ottawa, Can., for $1,500 a year.

The Glenwood & Marianna, Ga., Telephone company will establish a system between these two points.

Corpus Christi, Tex., is soon to be connected with Nueces and Sharpburg by telephone. Another project is now being entertained to connect it with Alice.

The New York & Pennsylvania Telephone company has commenced the construction of a long distance line from Jamestown to Elmira, N. Y., via Salamanca, Olean and Wellsville. A branch will be run from Carrollton to Bradford, Pa.

The Pacific Telephone & Telegraph company will issue bonds in June to the amount of $600,000 for the establishment of a direct line from San Francisco, Cal., to Los Angeles. The new line will be from San Francisco to San Jose, San Juan, San Luis Obispo, Santa Barbara and Los Angeles, a total distance of 500 miles. The largest poles and very heavy wire are to be used, putting the overhead system on a par with any of the kind in the East, and making it as satisfactory as the underground system is in its way in the city limits. The money is also intended to provide for the completion of the underground system in Los Angeles and to place all the wires in Oakland underground in the same way that they have been laid in San Francisco.

TELEGRAPH.

The Western Union Telegraph company is trying to get a subway franchise in Syracuse, N. Y.

India now boasts of one of the finest land telegraph services in the world. Recently duplex messages were transmitted without relays a distance of 2,100 miles, over a line extending from Calcutta to Madras. The wire employed was of copper, and the feat was rendered possible by the employment of an apparatus introduced by a member of the Indian telegraph staff.

The commercial telegraphers of Boston and vicinity will hold a fast sending tournament in the near future. Prizes will be given for various classes of work, including both sending and receiving and typewriter and code work. This will be the first fast sending contest ever held in New England and it will be confined to operators within that district.

POWER TRANSMISSION.

Plans for the electrical transmission of power from the Folsom dam, on the American River, to Sacramento, Cal., have been submitted by the General Electric company, the Westinghouse Electric company and the Siemens & Halske company of Berlin. These plans have been submitted to W. F. C. Hasson, as consulting engineer, and he will soon submit a report.

An application has been made to the Swedish government for a concession to install an electric transmission of power from the Dal river waterfall at Mansbo to the Norberg mining district, a distance of some ten miles. The power to be transmitted will be about 200 horse power, and the potential will be about 10,000 volts. The town of Ostersund will also soon have an electric transmission of power from the Strup waterfall of the Indal river, which has not yet been utilized. The distance is about eleven miles, and the tension of the current is also to be 10,000 volts.

Sacramento, Cal., has a second long distance power transmission scheme. C. Van Norden, of the South Yuba Water company, is examining the project of transmitting electric power from Placer county, fifty-four miles distant. At Cape Horn Falls the company has 10,000 miner's inches of water that fall a distance of 1,600 feet. The Cape Horn fall by no means represents the power going to waste in the company's system of canals. At Boulder Ridge, a few miles east of Rocklin, the water is brought down to a point 360 feet above Sacramento, thus affording an abundant fall to generate any power that may be required in the immediate future.

A long distance power transmission plant has been completed at Walla Walla, Wash., by the General Electric company for the Walla Walla Gas & Electric company. The electric power plant consists of a 200 horse power alternating current generator, which transmits the power over a wire from three to five miles to an alternating current motor in the present works of the Walla Walla Gas & Electric company, where it drives a direct current power and lighting plant for lighting the streets and stores of Walla Walla. The water power is taken from Mill creek, and conducted through a pipe line about 5,000 feet long to the power station at the junction of the Yellowhawk and Mill creeks. The water-wheel is of the Pelton type.

MISCELLANEOUS.

The city council of Baton Rouge, La., has decided to furnish the city with an electric automatic fire alarm system. Bids for the work are advertised and construction will be commenced as soon as possible.

The consolidation of the gas company and the electric light company of Georgetown, Colo., has taken place. The name of the new organization is the United Light & Power company, and its capital stock is $35,000.

Judge Thomas issued an order on April 25th to J. W. Foster and F. H. Jones, assignees of the Incandescent Light & Power company of Norwalk, O., to sell the company's property at public sale for cash in front of the court house in that city. The assignees have not yet determined on a date of sale. The property was appraised a few week ago at $35,025.

The entrance examinations of the Massachusetts Institute of Technology will be held at the Rogers building, 491 Boylston street, Boston, on June 29th and 30th. A second series for those unable to be present in June will be held on September 19th and 20th. For detailed information in regard to requirements for admission and for catalogues of the Institute, address H. W. Tyler, secretary, Massachusetts Institute of Technology, Boston, Mass.

A dispatch from Council Bluffs, Iowa., says that a heavy storm visited that section recently and did considerable damage. A dozen persons were the victims of electrical shocks, one case resulting fatally. D. W. Patterson was sitting near a window at his home, with his little daughter near him, when the side of the building was struck by lightning and Mr. and Mrs. Patterson were prostrated. The mother and daughter soon recovered and summoned assistance, but the physicians found that Mr. Patterson had been killed instantly.

TRADE NEWS.

The Bryant Electric company, which has secured control of the Cleveland arc light cut-out and Cleveland switch, announces that it will keep these devices in stock. The company's Chicago office is at 1522 Monadnock building.

The Hawley Furnace company has issued a sheet descriptive of its stock. The references given of satisfactory tests of the Hawley smokeless furnace form a special feature. The address of this company is 125-127 South Clinton street, Chicago.

"Premier Products and Specialties" is the name of a little hand-book issued by M. R. Rodrigues, Brooklyn, N. Y. It is descriptive of the Premier specialties and motors. The Premier battery is given much attention in this book, which is intended merely to be a pocket edition for reference.

The Shawmut Fuse Wire company, Boston, whose office and factory were damaged by fire recently, has opened a temporary office at 85 Water street and factory and storeroom at 54 Pearl street. The company is well equipped in its new quarters and will have no difficulty in giving orders prompt attention.

The exhibit of magnet, line and rubber covered wire in the Ansonia Electric company's booth at the World's Fair, will give its customers some idea of the complete line of wire which it carries. The company's new W. W. lightning arrester is giving the best of satisfaction and it is pre-

pared to furnish this specialty in large quantities on short notice.

The Rose Polytechnic Institute is one of the leading engineering colleges of the country, and is especially fortunate in its thoroughly modern equipment and plan of instruction. It lays special emphasis on the practical side of technical education, which it is enabled to do throughout the whole course of four years by its ample shops and laboratories and exceptionally complete outfit, especially in the electrical department.

The Chicago Insulated Wire company has recently been reorganized. This company was formerly controlled and owned by the Great Western Manufacturing company. Edward Carroll of Leavenworth, Kas., is now the principal stockholder and the president of the company. He assumed control on March 1st. The officers are as follows: President, Edward Carroll, Leavenworth, Kas; vice president and general manager, T. C. Turlay, Chicago, Ill.; secretary and treasurer, W. M. Smith, Sycamore, Ill.

The Electric Appliance company, Chicago, is preparing to distribute a new catalogue of Whitney voltmeters, ammeters and indicators, calling particular attention to the new alternating instruments. Particular attention is called to the alternating ammeters which are the first of the kind on the market. Heretofore accurate measurement of alternating currents has required the use of a dynamometer, but the Whitney company claims to have produced an ammeter reading to one-twentieth of an ampere and absolutely accurate.

No better illustration of the growth in the manufacture of insulated wire may be found than the fact that there is a new factory in Chicago devoted exclusively to the manufacture of reels and spools. A. D. Benham, 206 South Clinton street, makes a specialty of this business. A recent glimpse at the interior of his factory and salesrooms revealed a most extensive line of goods. Mr. Benham's factory has been rapidly growing, and having at the present time all the orders he can possibly fill with the present facilities, he is casting about for new and more extensive quarters.

The pocket edition, No. 5, of the Manhattan Electrical Supply company's catalogue is most complete and gives a brief but comprehensive description of the company's large assortment of electrical devices and specialties. An edition of 50,000 copies of this number has been printed. It is particularly interesting in the department of telegraph apparatus. This company has constantly on hand a large assortment of annunciators, push buttons, burglar alarms, call bells and buzzers. Just at present it is making something of a run on miniature incandescent lamps. They vary from ½ to six candle power. The company is located at 36 Cortlandt street, New York.

The Interior Conduit & Insulation company has issued a new catalogue. In addition to a description of the many devices applicable to interior wiring, the catalogue contains complete specifications for the installation of the interior conduit system and also a code for customers who may wish to order by telegraph or cable. The Johnson switch, the Lundell motor and all devices are constructed to conform to standards and are particularly applicable to the Edison system of distribution. As it is practically impossible to catalogue at any given time all the improvements and new developments, the Interior Conduit & Insulation company respectfully solicits inquiry as to any device, method or apparatus which may not appear in the catalogue before excluding it from the opportunity of supplying the same.

No more complete catalogue of electric railway supplies has been published than the book recently issued by the Railway Equipment company of Chicago. The book comprises over two hundred pages, is neatly bound, well illustrated, and there is no article known to the street railway business that is not included in the stock of this company. Line material, track material, car equipments, station material and special tools all receive their due share of attention. In the back of the book will be found wire tables, and other tables useful to the trade. The book also contains an article descriptive of the electric railway, the process of its construction and equipment, and the means that should be employed to place it on a paying basis. It is a book that commends itself to the trade, and will give a good idea of the magnitude that the electric railway supply business has assumed.

BUSINESS.

The Ansonia Electric company, formerly the Electrical Supply company, recently secured an order for the entire equipment of the Columbia, Mo., plant with Stanley transformers.

The Donaldson-Macrae Electric company of Baltimore reports a good demand for its battery and fan motor outfit. It has recently equipped the telephone exchange at Baltimore with a number of its 150 ampere batteries, and also the Postal Telegraph company of Baltimore with 480 small cells of 25 amperes.

The Cutter Electric & Manufacturing company, Philadelphia, reports a large business for the past two months for its various specialties. Among the recent contracts closed for complete electrical work in its line are the St. Clair hotel, Detroit; Regent hotel, Brooklyn; Cornelius Vanderbilt's new home at King's Park, L. I., in which will be placed 900 key switches, and the New Home building, Pittsburg, Pa.

There is no doubt, generally speaking, that many of the exhibits in the electricity building and machinery building at the World's Fair are in an unfinished state, but it must be said to the credit of a number of firms making displays in these departments that there are a few which have exhibited creditable promptness. Among this number is the Campbell & Zell company of Baltimore, Md. This firm has a large battery of its boilers in operation in the machinery building, and according to W. A. Ross, the company's western representative, this very large exhibit is all finished, "except the white paint on the boilers." And, by the way, it should be stated that Mr. Ross is no more enthusiastic over the white paint order than are many of the other electrical and mechanical exhibitors.

The Elektron Manufacturing company is experiencing a lively demand for its improved electric elevators, and for the convenience of customers in that vicinity it has opened an office at 103 Milk street, Boston, and has appointed E. Marshall as manager of the elevator department and F. B. Corey as manager of the electrical department. Mr. Marshall has had a long experience in the elevator business in connection with the Otis & Graves hydraulic and power apparatus. The Boston office has recently installed electric elevators for Messrs. Curtis & Bolster, 2304 Washington street, Boston, and Frank Ferdinand, 2280 Washington street, Boston. The main office of the Elektron company at Springfield has recently sold electric elevators to the new Masonic Hall, Springfield, Mass; Brown, Thompson & Co., Hartford; W. H. King & Son, Springfield.

ELECTRICAL PATENTS.

Issued May 16, 1893.

497,310. Automatic Disconnector. William A. Cullen, Paterson, N. J.

497,324. Process of Making Mica Insulating Plates. Charles W. Jefferson, Schenectady, N. Y.

497,331. Automatic Time Stamp. Warren B. Martindale, Rochester, Ind.

497,335. Manufacture of Telephone Cables. William R. Patterson, Chicago, Ill

The invention comprises means for giving to the conductors of a strand a variable pitch, so that when two strands are placed alongside of one another the conductors of one strand will not be parallel to the conductors of an adjacent strand, induction being thereby prevented. In forming the strands the wires are fed forward at a uniform rate, while the twist is effected at a variable rate, or the conductors are fed forward at a variable rate, while the twist is effected at a constant rate.

497,336. Insulating Tape. William R. Patterson, Chicago, Ill.

The tape is weakened along one or more lines, so that when it is spirally wound around a conductor it is caused to buckle along one or more lines to form a helical ridge. Several tapes being thus wound one upon the other, considerable air space is left between the different layers, thus effecting an insulation having a low specific inductive capacity.

497,337 Overhead Electric Railway. William D. Patterson, Keokuk, Ia.

The trolley wheel is adapted to bear upon the upper side of the trolley wire, breakers being interposed between the sections of the trolley wire of a depth greater than the distance that the periphery of the grooved wheel extends below the upper surface of the wire. The switch upon the track is set in advance of the trolley switch, so that by the time the trolley wheel reaches the switch the car will have assumed a position at an angle to the trolley wire, thus causing the trolley wheel, when it reaches the interposed breaker, to swing at an angle so as to straddle the end of the branched section as the car proceeds upon the branch track. The trolley wire proper is supported by means of forked posts upon a pair of wires placed parallel and in substantially a horizontal plane, the posts being secured to the trolley wire, but fitting loosely upon the parallel wires, so that the trolley wire may be drawn up independently.

497,356. Electric Car Truck. George S. Strong, New York, N. Y.

497,361. Commutator Brush Holder for Dynamo electric Machines. Elihu Thomson, Swampscott, Mass.

497,366. Rheostat. Parvin Wright, Denver, Colo.

497 377. Trolley for Conduit Railways. Paul C. Just, Chicago, Ill.

497,382. Non-conducting Covering. Robert H. Martin, Brooklyn, N. Y.

497,394. Conduit Electric Railway. George Westinghouse, Jr., Pittsburg, Pa.

497,397. Lightning Arrester. Alexander Wurts and Charles F. Scott, Pittsburg, Pa.

Between the generator and the line supplied are placed a number of self-induction coils which do not impede materially the generator currents, even though they be alternating, but which will tend to choke lightning discharges of high frequency. Several such coils are placed in series, and their ends connected with plates immersed in a tank of running water. On account of the high resistance to ground through the water, but little leakage of dynamo currents takes place, while if a lightning change comes upon the line the same will pass to ground through the water and will be prevented from passing to ground through the self-induction coils, due to the opposing electromotive force produced therein.

497,404. Electric Cigar Lighter. William P. Carstarphen, Jr., Denver, Colo.

497,408. Electric Railway Signal. William H. Jordan, Brooklyn, N. Y.

497,411. Push-button Switch. Fred S. McGregory, Revere, Mass.

497,430. Circuit Protector. Harry W. Leland, Jersey City, N. J.

497,436. Sectional Contact Conductor for Electric Railways. George Westinghouse, Jr., Pittsburg, Pa.

497,438. Arc Electric Lamp. John C. Wray, Peoria, Ill.

497,439. Wire Hanger. Arthur J. Wylie, Rome, N. Y.

497,443. Galvanometer. Adrian H. Hoyt, Manchester, N. H.

497,449. Galvanometer. Adrian H. Hoyt, Manchester, N. H.

497,450. Electric Arc Lamp. Rudolph M. Hunter, Philadelphia, Pa.

The lamp is designed for constant potential circuits where it is customary to place two lamps in series, in order to secure the proper voltage for each lamp. The lamp is provided with three carbons, a middle one and two extreme carbons, two arcs being formed, one between each end of the middle carbon and the end of the adjacent extreme carbon. Regulating mechanism is provided for feeding the carbons. The arcs are connected in series.

497,468. Dynamo-electric Machine or Motor. Walter K. Freeman, Boston, Mass.

497,482. Shunt for Electric Light and Power Stations. Edward Weston, Newark, N. J.

497,489. Circuit Controlling Device. John P. Buchanan, Boston, Mass.

497,491. Automatic Cut-out for Electric Light Circuits. Charles Cuno, Wauwatosa, Wis.

497,494. Electric Arc Lamp. James Einstein, Munich, Germany.

497,495. Electric Rink. Midbury W. Hassan, Rochester, N. Y.

497,504. Armature Core for Electric Motors. James E. Stuart and Ulysses S. James, Helena, Mont.

497,507. Lightning Arrester. Alexander Wurts, Pittsburg, Pa.

A wire is run from the line to be protected to an artificial ground. The artificial ground is insulated from the earth for generator currents, but has sufficient conductivity to permit static charges of high potential to pass to ground. By this construction a path to ground is maintained at all times for static charges, thus preventing the accumulation of a high static charge and readily permitting the passage of such a charge when instantaneously formed.

497,508. Lightning Arrester. Alexander Wurts, Pittsburg, Pa.

When both sides of an electric circuit are statically charged and one side is discharged, as by a lightning arrester, a charge passes from one side of the circuit to the other through the generator, or translating devices, to establish equilibrium between the two sides, often causing injury in its passage. To prevent this a condenser is placed between the two sides of the circuit and the charge is transmitted from one side to the other through the condenser, thus protecting the generator and translating devices.

497,509. Lightning Arrester. Alexander Wurts, Pittsburg, Pa.

A condenser is connected between the line to be protected and ground, thus permitting the passage of an instantaneous charge, while in shunt with the condenser is a wire of high resistance, which permits gradual discharge of low charges as they form, while preventing passage of an appreciable dynamo current to ground.

497 513. Hydrothermal Mining Process. Charles W. Beehler, St. Louis, Mo.

497,515. Insulator. Thomas H. Brady, New Britain, Conn.

497,521. Electric Measuring Instrument. Adrian H. Hoyt, Manchester, N. H.

497,522. Galvanometer. Adrian H. Hoyt, Manchester, N. H.

497,529. Stop Mechanism for Steam Engines. William M. Wood, Elmira, N. Y.

497,535. Process of Manufacturing Electric Conduit Sections. James F. Cummings, Detroit, Mich.

497,536. Underground Conduit for Electrical Conductors. James F. Cummings, Detroit, Mich.

497,539. Electrical Measuring Instrument. Oscar Frölich, Berlin, Germany.

The instrument is constructed on the principle that when two currents flow at right angles a magnetic needle assumes a position corresponding to the resultant force. In order to adapt this principle to measurement of the strength of a current, one of the perpendicularly flowing currents is maintained constant, while the other to be measured causes a deflection of the needle proportional to the current to be measured.

497,540. Device for Illuminating Gun Sights by Electricity. Giovanni G. di Giovanni, Turin, Italy.

Means are provided, such as a small incandescent lamp and a battery, for illuminating the sight of a gun at the moment of aiming and firing at night or in the dark. A key is provided under control of the person using the gun for closing the circuit and effecting the illumination as desired.

497 552. System of Conductors for Electric Fire Engines. Joseph Sachs, New York, N. Y.

497,558. Electric Arc Lamp. Frank H. Thompson, Philadelphia, Pa.

497,563. Electric Pump Governor. Charles R. Whittier, New York, N. Y.

497,585. Closed Conduit for Electric Railways. Archibald J. Martin, Philadelphia, Pa.

497,621. Process of Electro Tin Plating. Louis Aronson, New York, N. Y.

497,649. Magneto Telephone. James P. Freeman, Washington, D. C.

497,680. Safety Cut-out Apparatus for Networks of Multiple Electrical Conductors. Paul Nordmann, Berlin, Germany.

497,732. Binding Post Fuse. Simon H. Stupakoff, Pittsburg, Pa.

497,733. Wire Tightener. Simon H. Stupakoff, Pittsburg, Pa.

497,755 System of Electrical Distribution. Waldemar Meissner, Königsberg, Germany.

The translating devices are connected between a number of parallel conductors, the extreme conductors being connected with the terminals of a dynamo. In order to maintain the potential difference between the other conductors, auxiliary generators are connected between one of the extreme conductors and each of the other parallel conductors.

497,756. Circuit Switch. Ernst Woltmann and Harry A. Triggs, Denver, Colo.

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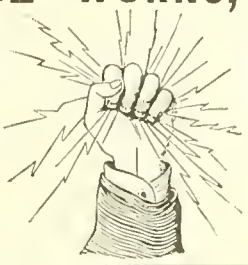

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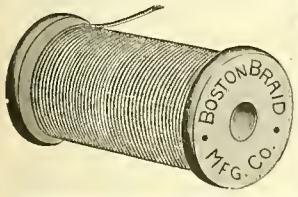

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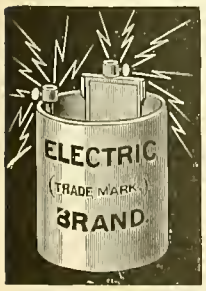

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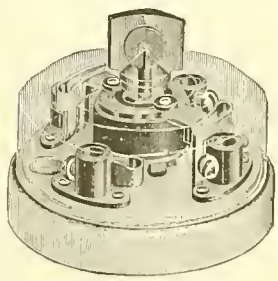

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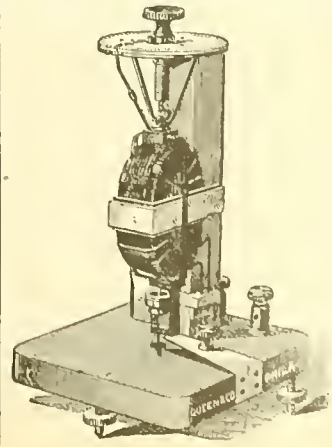

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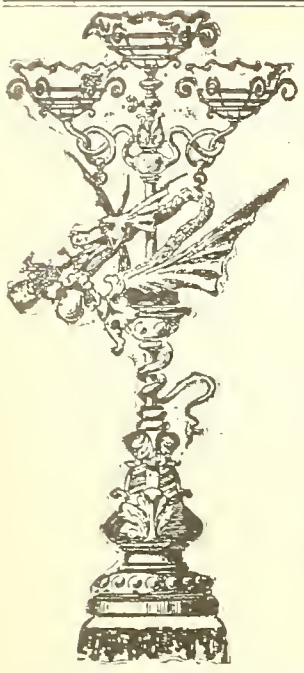

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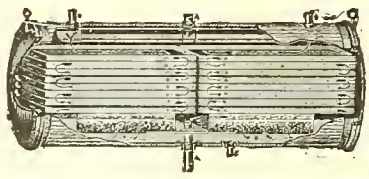

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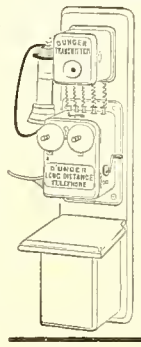

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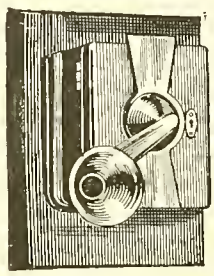

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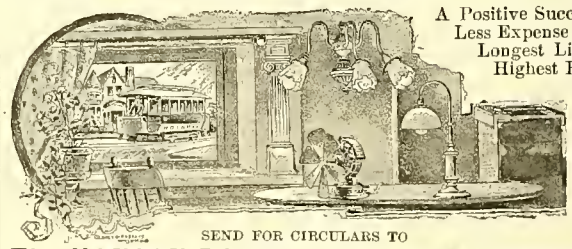

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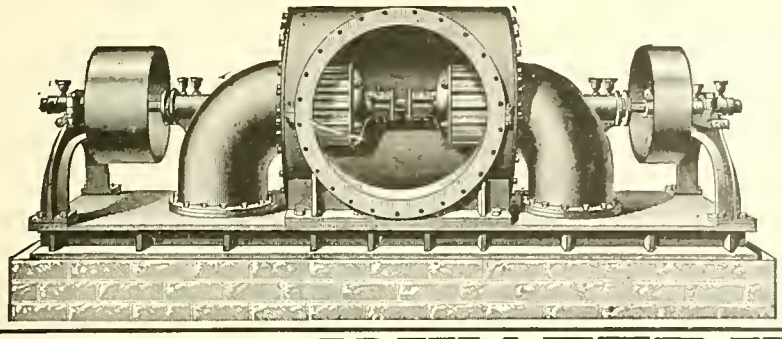

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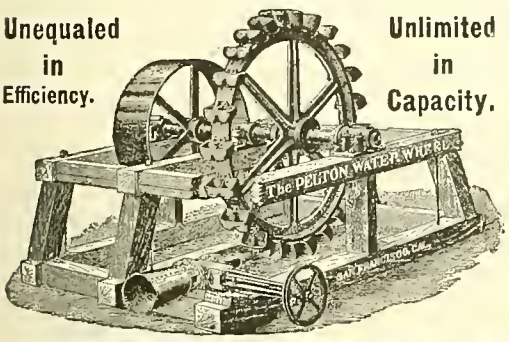

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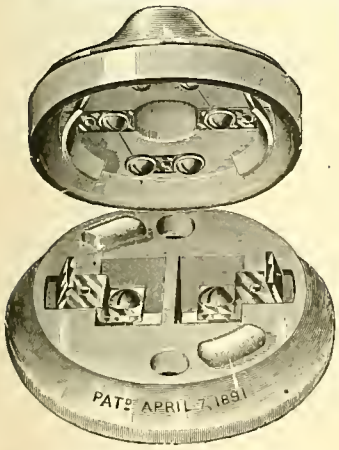

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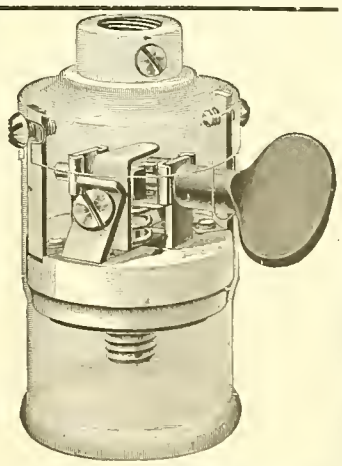

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Notice is hereby given that in pursuance of an order of the Circuit Court of Milwaukee County, Wisconsin, I will, on the 30th day of June A. D. 1893, at eleven o'clock in the forenoon of said day, at the south door of the Court House in the city and county of Milwaukee, Wisconsin, offer for sale and sell at public auction as an entirety, the street railway of the Milwaukee Electric Railway Company in said city of Milwaukee, with all the franchises and rights and privileges of said railway company for the operation and maintenance of the same, and all the property of said corporation used in or in connection with, or essential to the exercise of its said franchises.

Said railway property and franchises consist of about 6¼ miles of double track, being about 13 miles of single track, in said city of Milwaukee, with all the poles, wires, cables, trucks, ties, stringers, fixtures and appliances composing or used in connection with said tracks or said railway, with franchises, privileges and rights derived from ordinances of the common council of the city of Milwaukee to maintain and operate said road; also sundry parcels of real estate in said city, with car barns and power house thereon; also the engines, boilers, machinery and rolling stock and supplies of said road.

The terms of such sale are cash.

The said street railway will be sold free of all liens and encumbrances except judgments of foreclosure and sales aggregating $21,193.56, with interest from the 22d day of November, 1892, at 7 per cent. on $1,259.60 thereof, and at 6 per cent. per annum on the remainder. Said judgments of foreclosure covering the said specific parcels of real estate.

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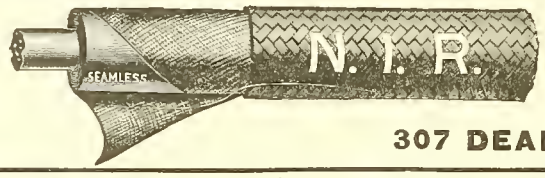

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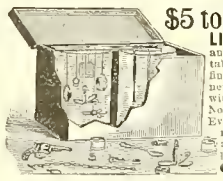

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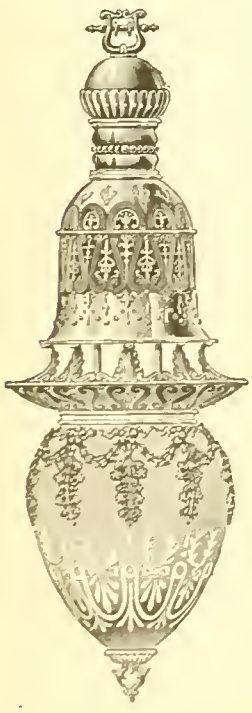

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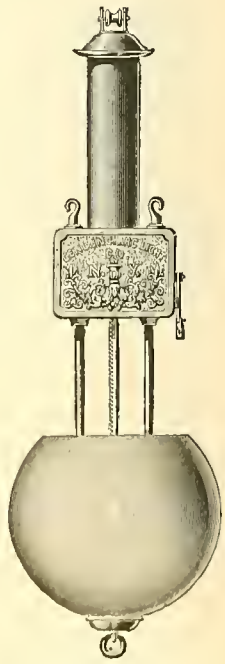

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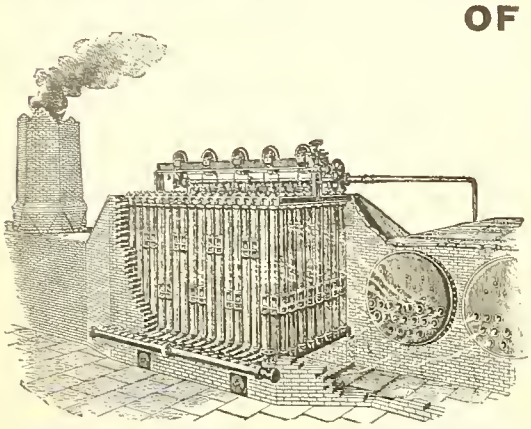

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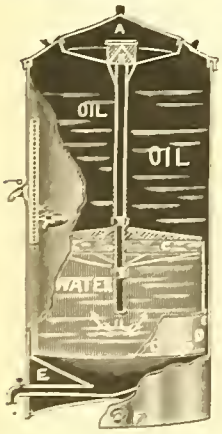

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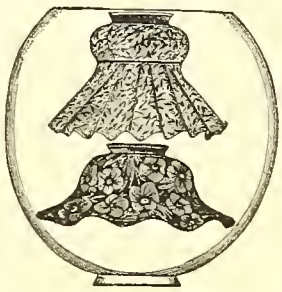

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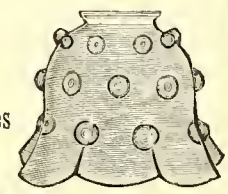

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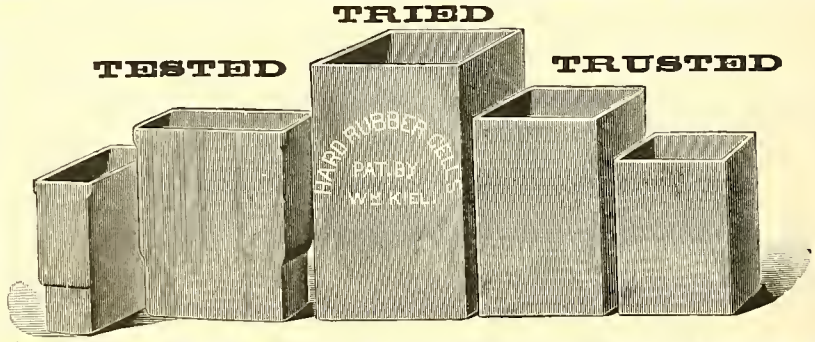

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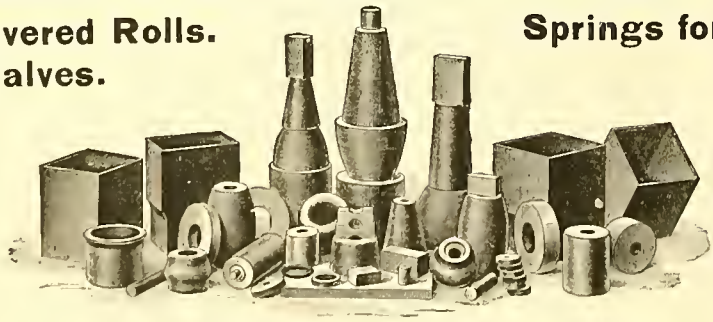

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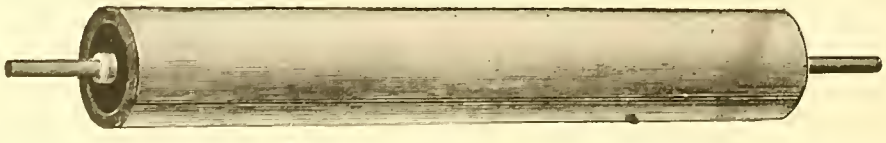

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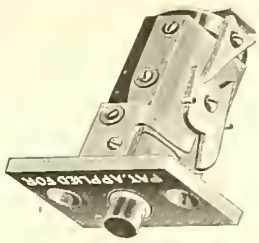

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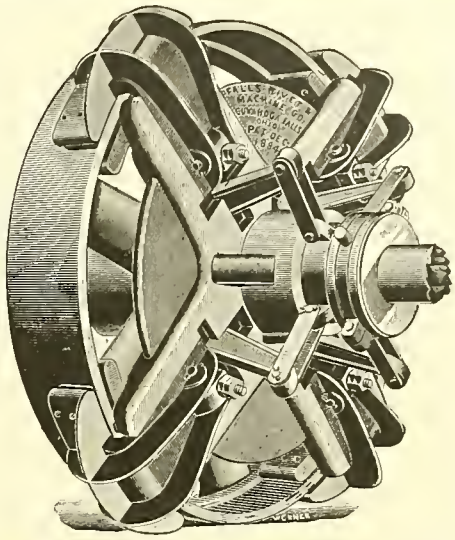

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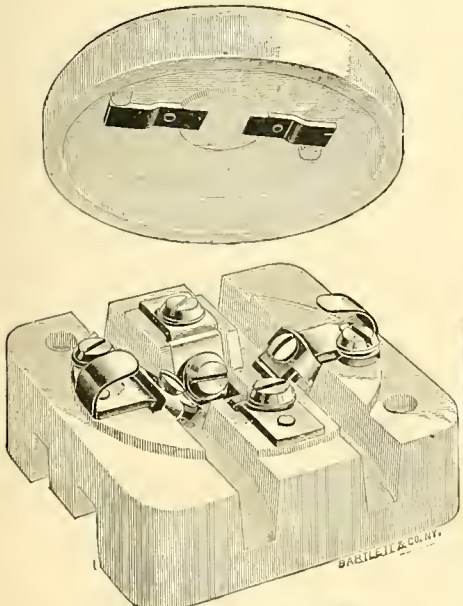

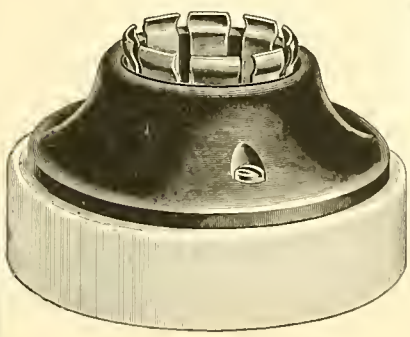

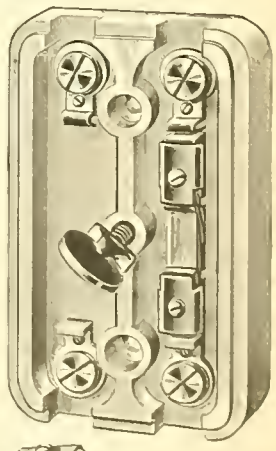

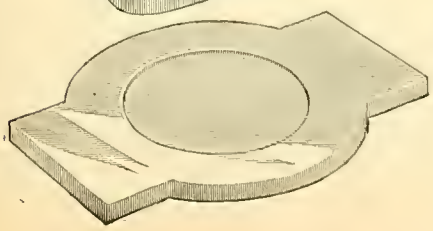

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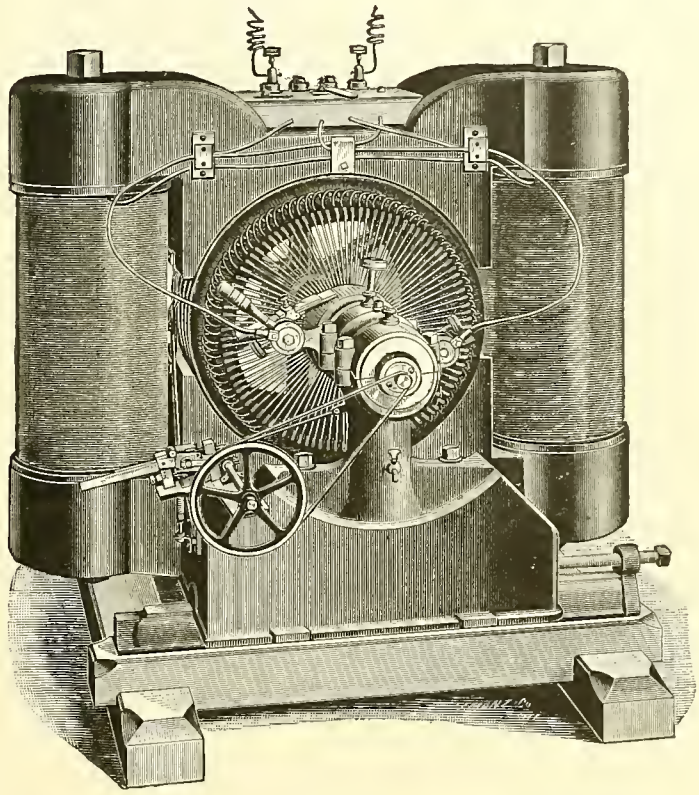

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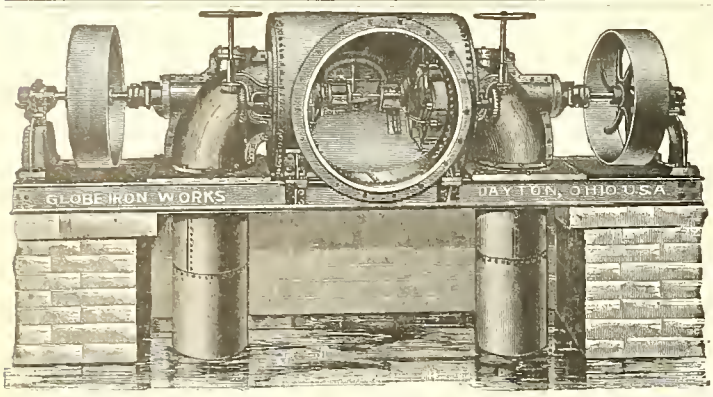

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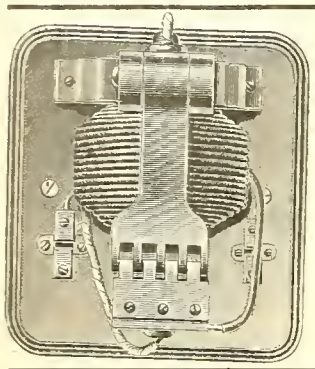

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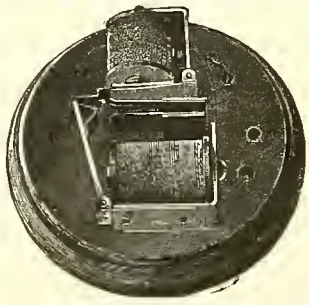

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38 Standard Engines, 1965

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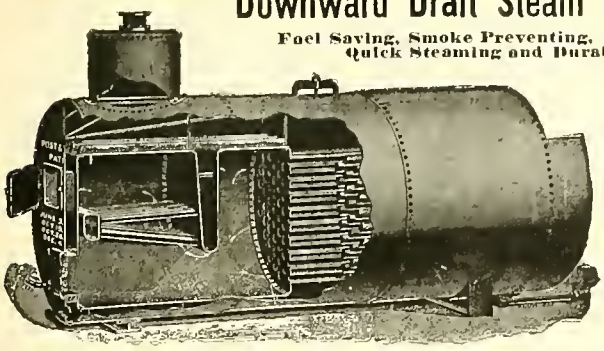

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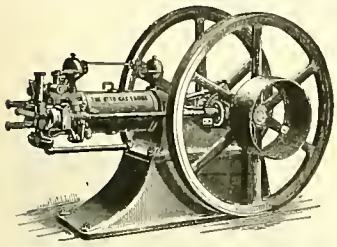

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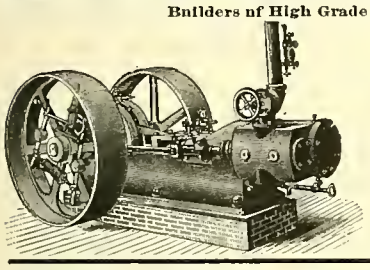

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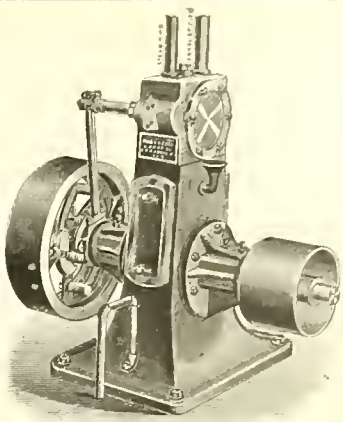

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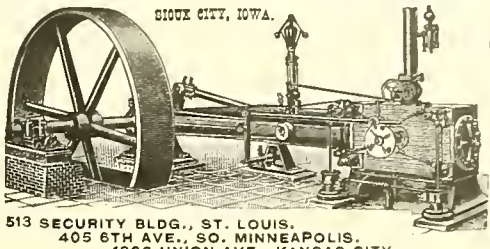

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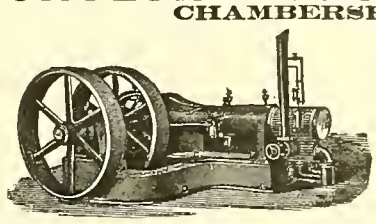

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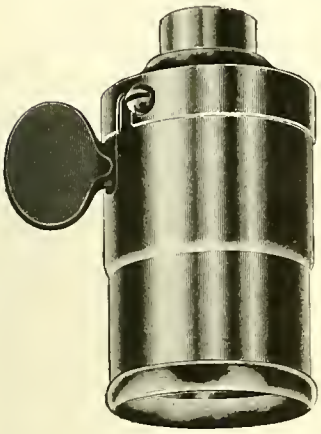

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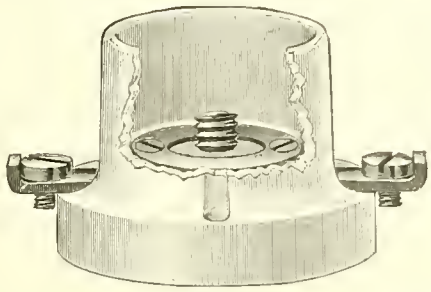

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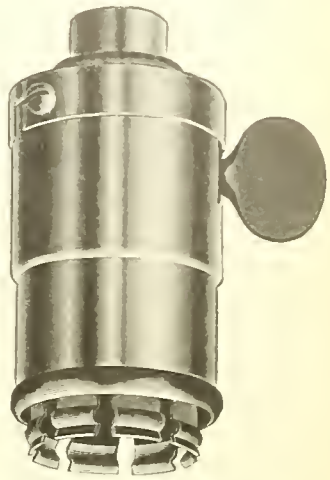

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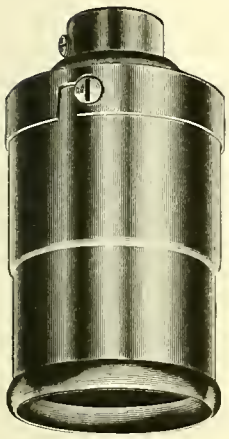

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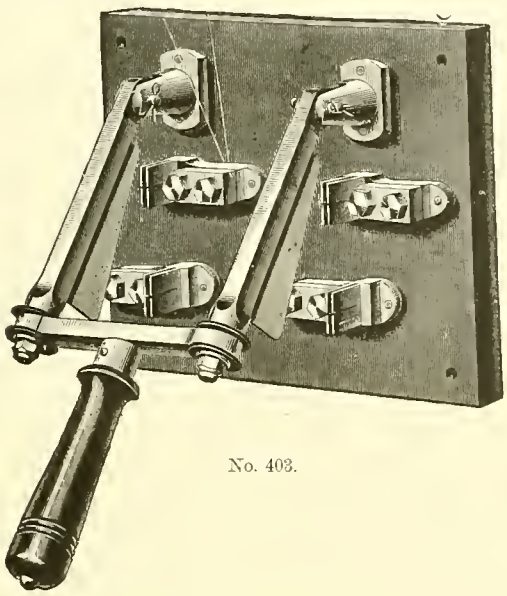

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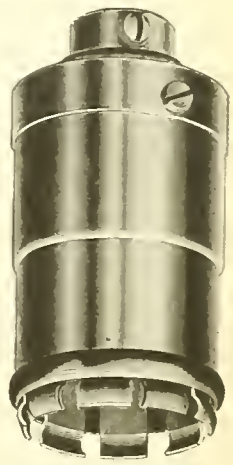

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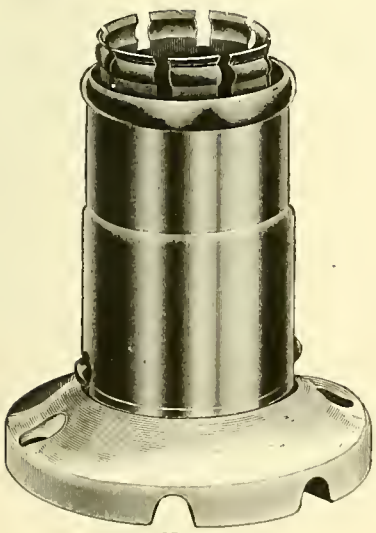

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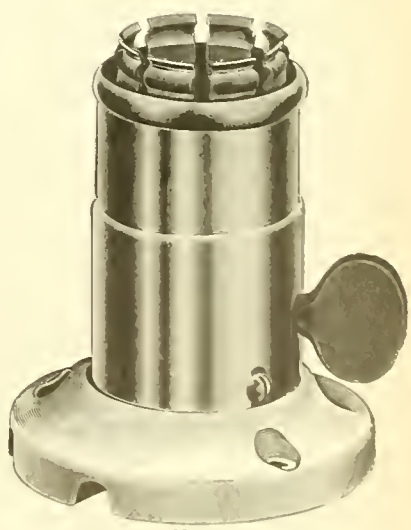

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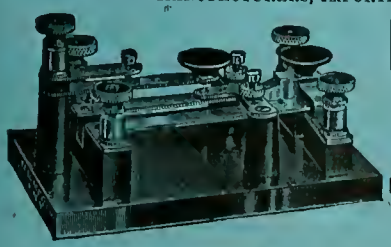

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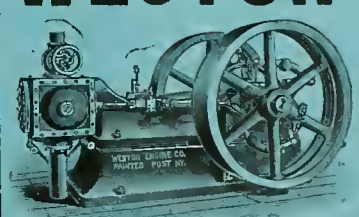

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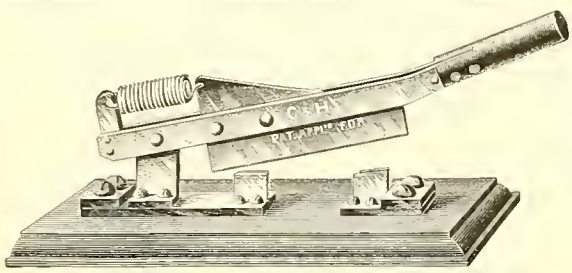

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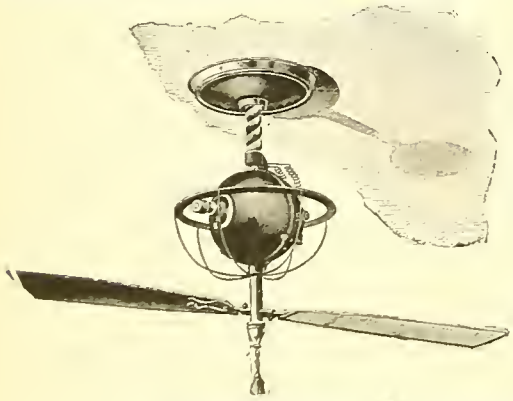

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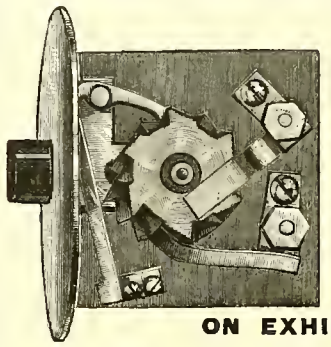

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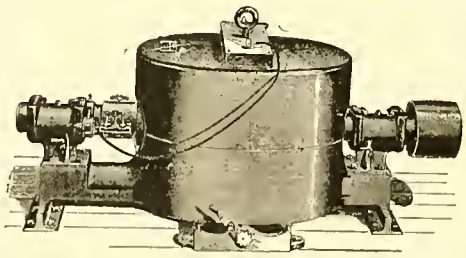

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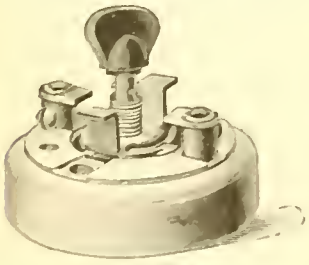

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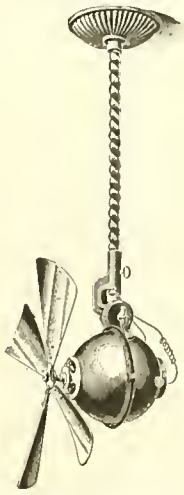

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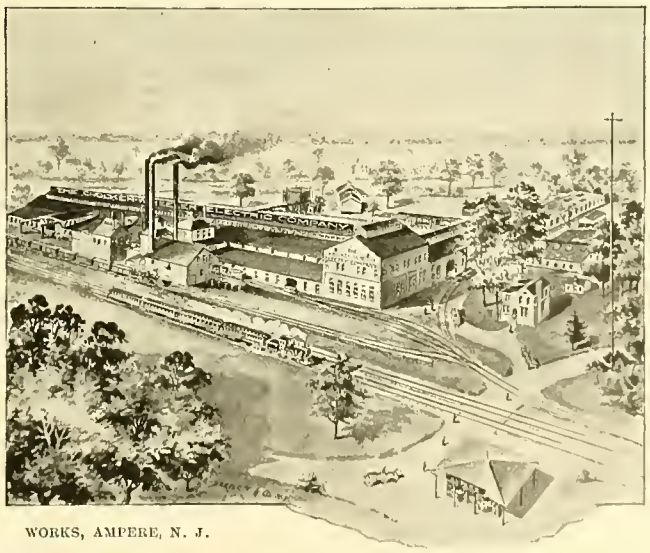

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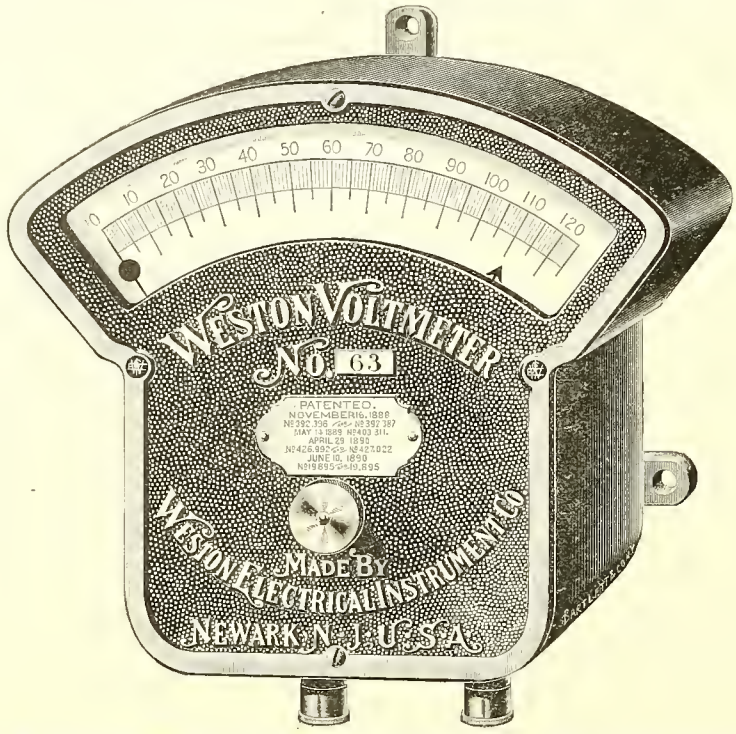

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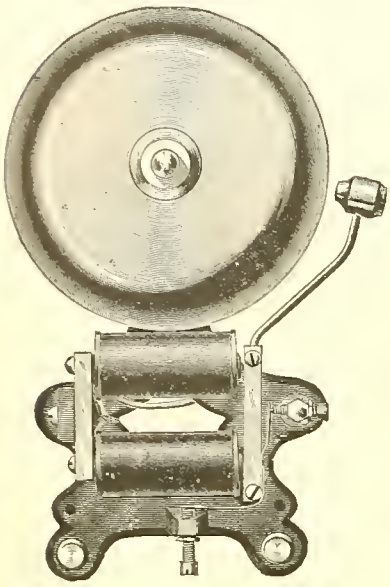

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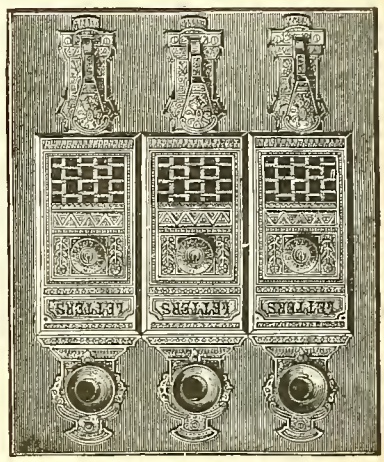

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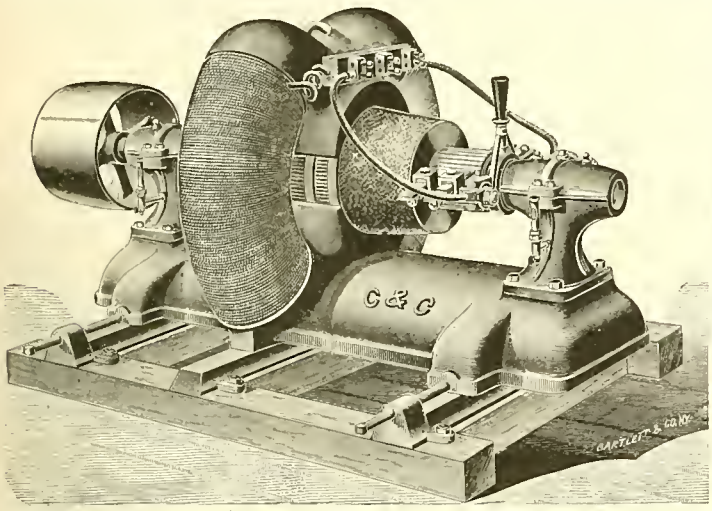

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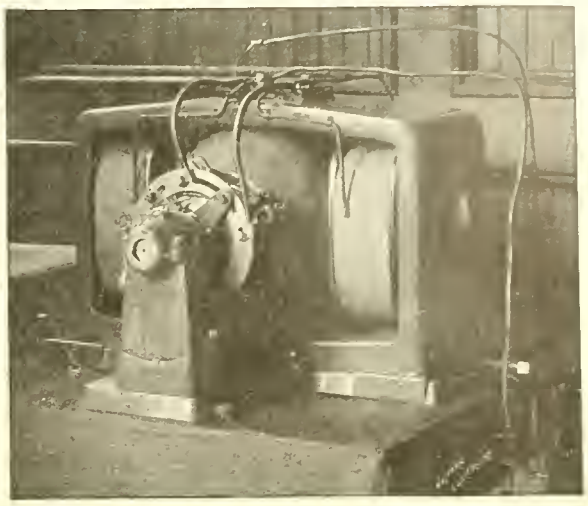

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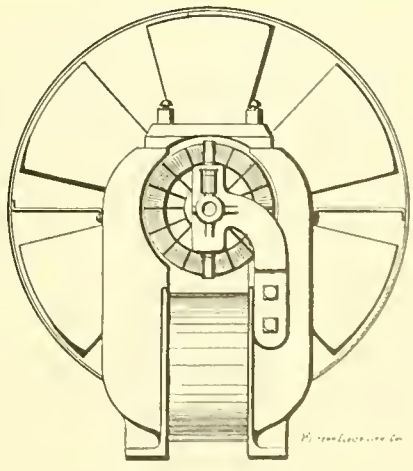

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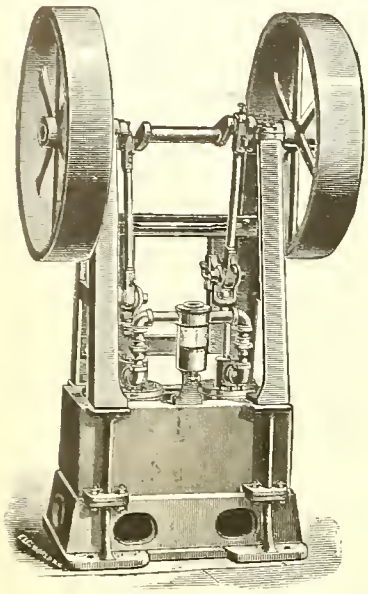

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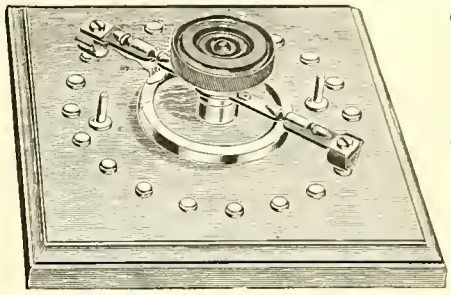

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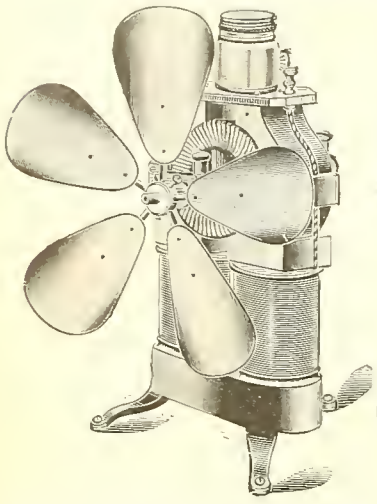

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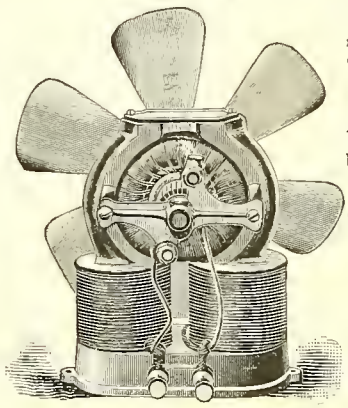

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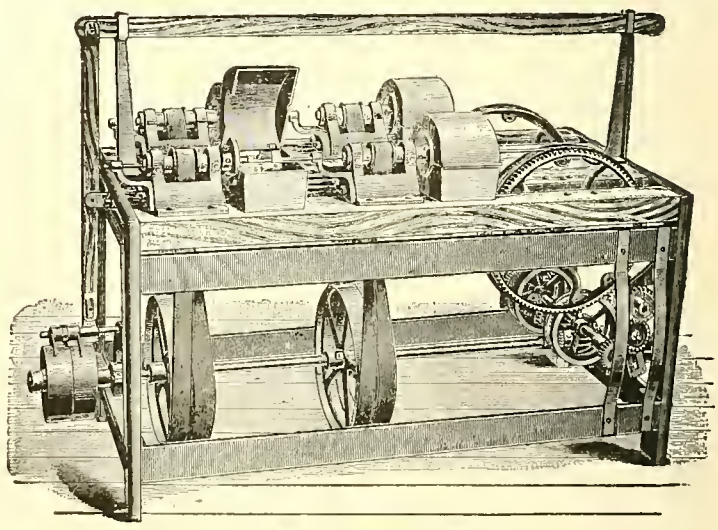

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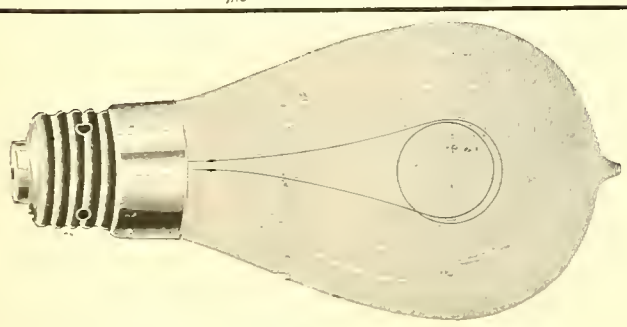

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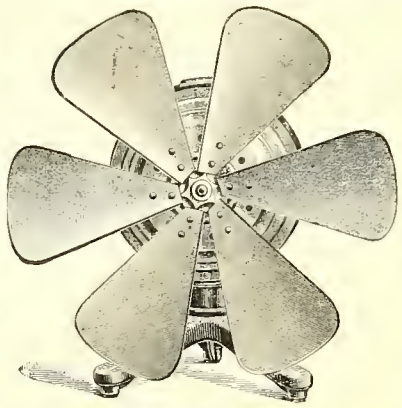

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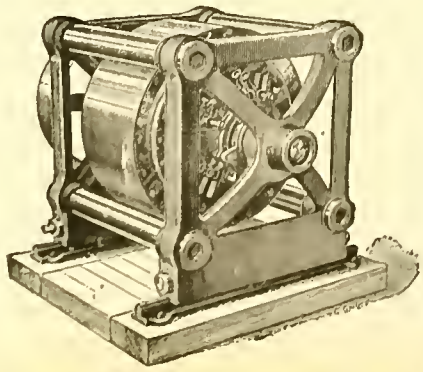

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Vol. XII. CHICAGO, JUNE 3, 1893. No. 22

Electricity at the World's Fair.

This is the week that will mark the formal opening of the electricity building at the World's Fair, and no better occasion could be chosen, therefore, for the presentation of an illustration of the most prominent feature of the building, the Edison "tower of light," which rears its graceful outline in the exact center of the structure. The picture given on this page is the first authentic representation of this striking portion of the electrical display to be made public and is a reproduction from a photograph. Some amusing pictorial guess-work in relation to this tower has been published, but the readers of the WESTERN ELECTRICIAN will have the satisfaction of possessing the first illustration showing exactly what this much-talked-of tower looks like.

The space on which the tower stands was originally allotted to the Phœnix Glass Works, which proposed to erect a glass pagoda, with incandescent light effects, but the General Electric company, whose space surrounds this allotment on every side, was also anxious to possess this desirable location, and so it came to pass, after many consultations between the gentlemen interested, that an agreement was reached by which the General Electric company was to erect the present structure, and the space about the base, enclosed by the colonnade, was to be devoted to the Phœnix company's exhibit. This plan was carried out, with the result shown in the illustration.

The "tower of light" is intended as a glorification of the Edison lamp and the Edison system of incandescent lighting. In these troublesome days of lamp litigation, therefore, it possesses more than ordinary significance. It was designed by Luther Stieringer for the General Electric company, and the plan was approved by Mr. Edison. The tower is 82 feet high and arises from a circular pavilion 32 feet in diameter. The glass exhibits in this pavilion are grouped in the space between the base of the column, which is polygonal and faced with mirrors, and the circular row of columns supporting the roof of the pavilion. Above the pavilion is a graceful cylindrical shaft of staff ending in an elaborately ornamented and gilded capital. The surface of the shaft is relieved by dark lines of molding, arranged in geometrical designs, as shown in the illustration, with little six candle power lamps of different colors inserted at frequent and regular intervals. Surmounting the capital of the shaft is the crowning feature, literally and metaphorically, of the tower. This is the great prismatic bulb composed of about 30,000 pieces of cut glass, arranged on a stout framework in the shape of an incandescent lamp. This mammoth lamp is about eight feet high and four feet in diameter at the point of greatest width. It was made by F. McLewee & Son of New York city. The prisms are made of cut glass and are only about three-fourth of an inch in diameter. To place each one in position required the services of two men, one working inside and one outside of the bulb frame. The frame is made of angle iron and covered with a wire hood, the shape of an incandescent lamp. The prisms were attached to the outside of the wire hood, and it took eight men five weeks to construct the bulb. Each prism was fastened with copper wire in order to avoid corrosion, this being the best metal for such purpose. The weight of the bulb complete is 1,000 pounds.

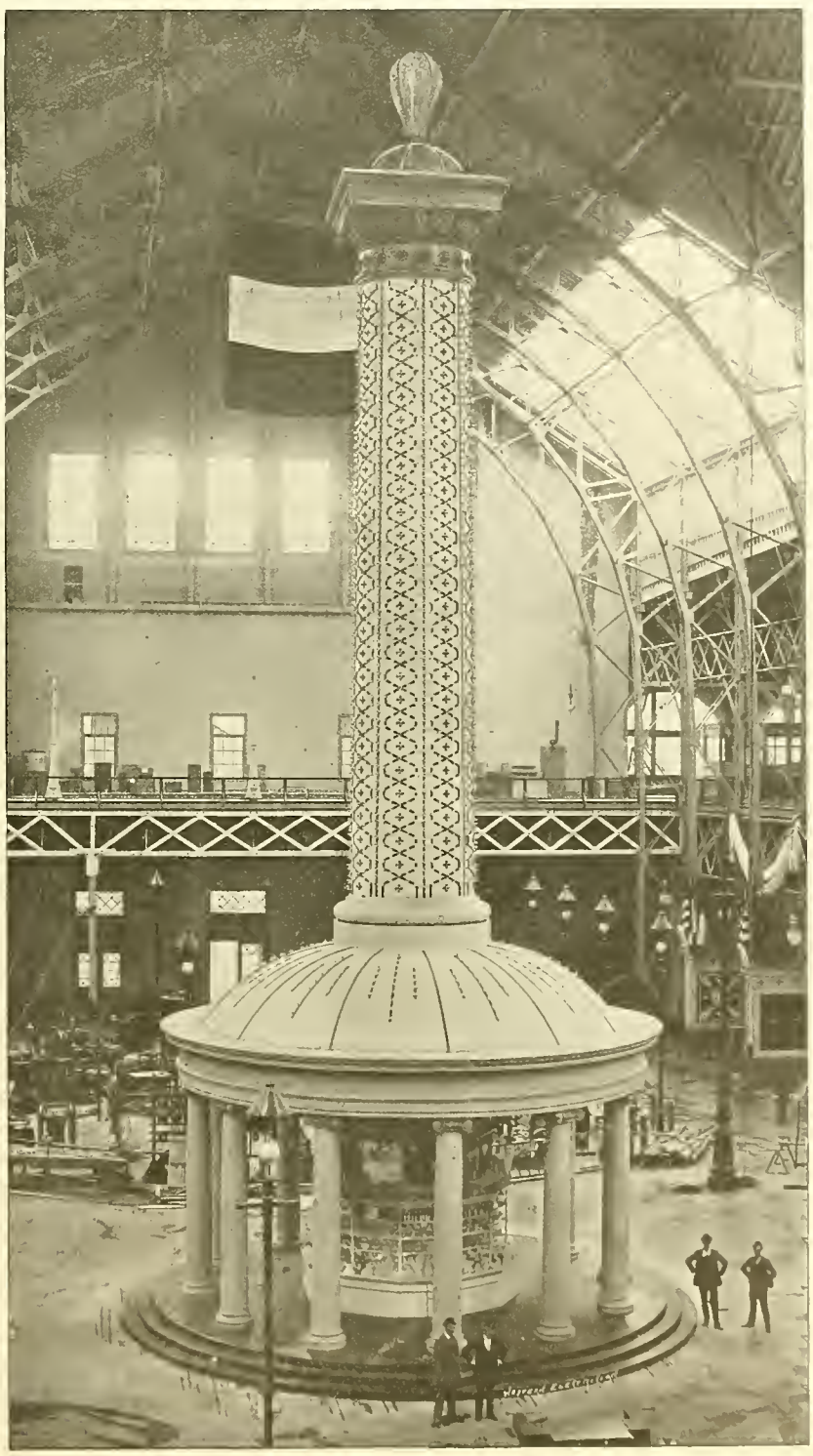


FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.—THE "TOWER OF LIGHT," ELECTRICITY BUILDING.

As the illustration proves the tower is handsome and impressive when not illuminated, but at night, with its 5,000 little points of red, white and blue light and the great bulb, lined with incandescent lamps of ordinary size, flashing and scintillating in every direction, the effect will be very striking and beautiful. The lamps on the shaft are wired in such a manner that the designs formed by the lines of light can be changed at will. The "tower of light" will linger in the memory of the visitor as one of the most beautiful spectacles at the fair.

Every section of the electricity building now lacks but a few finishing touches to be complete. The General Electric company has nearly finished its scheme of decoration, which includes flags and bunting, ornamental fixtures and colored lamps. A specimen of the treatment is shown in the corner illustrated in Fig. 2.

The new three-phase dynamos and motors will be quite extensively exploited at the exposition, for, in addition to the display made by the Allgemeine Elektricitaets Gesellschaft of Berlin the General Electric company makes an extensive showing in this line. Fig. 3 illustrates a 10 horse power three-phase motor directly coupled to a hoist, with a switchboard arranged for the multiphase system. This motor is designed to run at 900 revolutions per minute and is self-starting. Its switches are mounted on hard rubber bases. The drum of the hoist is 30 inches in diameter, with a 24 inch face, and is provided with band brakes.

Workmen are at last at work embellishing the unsightly expanse of blank wall at the southern end of the nave of the electricity building. The decoration is in the hands of the Westinghouse Electric & Manufacturing company, and although the plans have not been divulged, it is reported that the principal embellishment will consist of a figure of Columbus, eight or nine feet high, done in colored incandescent lamps and surmounted by an illuminated sign. This is an advantageous location for a decoration of this character, and it will undoubtedly attract much attention. It is also rumored that the Westinghouse company will have a similar wall decoration in machinery hall.

The appointment of William Wilson Primm as engineer of the department of electricity at the World's Fair has been formally approved. Mr. Primm has long been connected with the department, and this recognition of the value of his services is well deserved.

Among the recent visitors to the World's Fair was Arthur Bergtheil, of the firm of Bergtheil & Young, electrical engineers of London.

The subject of appointing judges and making awards is exciting much attention among the exhibitors in the several departments, and the system proposed is coming in for a good share of criticism. The executive committee on awards has one plan, however, that will probably meet with general approval. This consists of sending out blanks to absent exhibitors, who, by filling in the vacant spaces, will be enabled to set forth the claims of excellence made for their exhibits to the greatest advantage. These claims will be passed upon by the examining judges, so that exhibitors who are not present will be at little disadvantage. Each distinctive exhibit is to be described on a separate blank. Chief Barrett has a number of these blank forms, which he will distribute to absent exhibitors in the department of electricity.

The formal opening of the electricity building has been set for June 1st. On the evening of that day the Edison "tower of light" will be unveiled. The lights on the tower were successfully tested on Friday evening of last week. The Westinghouse company is finishing a beautiful golden pavilion north of this central tower, and these two structures, with the French beacon tower and the Bell telephone pavilion, constitute the most striking features of the nave of the building. The galleries are now well cleared up and everything will undoubtedly be ready on the date set for the formal opening.

One of the most valuable portions of the display in electricity building is in the northeastern gallery, where the German scientific instruments are displayed. Although many electrical measuring instruments are shown, there are also surgical, optical and meteorological instruments, as it was not deemed wise to divide the national showing in instruments of precision. One of the curiosities is a complete model of a boiler and steam engine so small that it is enclosed in a walnut shell.

There is no more attractive wire exhibit in electricity building than that of Day's kerite, which is located in the southeastern portion of the gallery, near the offices of the department of electricity. As will be seen by the photographic reproduction in Fig. 1, the display is admirably designed and gives a very pleasing impression. Over 1,000 square feet is taken up by the display, which comprises a complete exhibit of insulated wires and cables for all electrical purposes, including electric light and power, telephone and telegraph. An extensive showing of kerite elastic tape for insuring water-proof joints is also made. To the average visitor one of the most interesting features will be the four growing rubber trees and the samples of crude Para rubber and crude kerite, showing the foundation of this widely known insulation. A number of photographs showing the manner of laying a kerite submarine cable are also shown. The particular instance depicted is the laying of an 18-conductor cable across the Hudson River at New York city for the Metropolitan Telephone company. In the center of the exhibit is a graceful pavilion in white and gold which forms the office and reception room of the company and to which the friends of kerite are extended a cordial welcome. The interior of this little snuggery is finished in sycamore and resembles the cabin of a handsomely furnished yacht. The furniture, decorations and incandescent lamps are all such as are supplied for the highest class of pleasure vessels. Even the door is of the regulation cabin pattern, and the cabinet is an exceptionally fine piece of workmanship. The entire pavilion was built in Waterbury, Conn., in sections, and then taken apart, shipped to Chicago and again erected. It is dainty and elegant in every appointment. The exhibit is in the competent hands of A. P. Eckert, who takes pride in showing the medals awarded to his company at the Centennial and at the Paris Exposition of 1878.

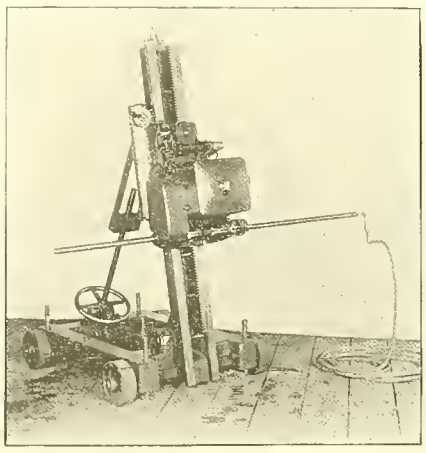


FIG. 5. ELECTRICITY AT THE WORLD'S FAIR.—ELECTRIC DIAMOND GADDER, ELECTRICITY BUILDING.

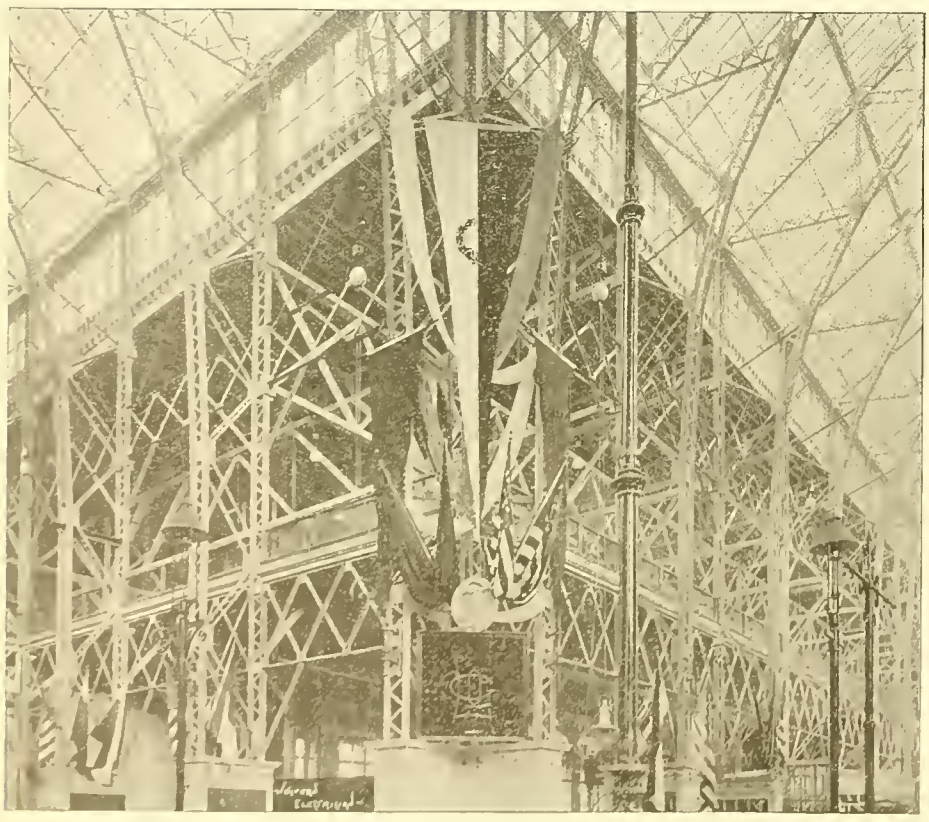


FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.—A CORNER IN THE ELECTRICITY BUILDING.

In the line of electric drills and mining machinery the General Electric company will make a large display. A new machine which will be shown is the electric diamond gadder, Fig. 5, which is used for putting a series of holes on a true line in stone, for the insertion of plugs and feathers for breaking up the block. The machine consists of an electrically driven rock drill mounted upon, and made to traverse, a standard or post, which is attached by trunnions at the lower end to a cast-iron bed piece, and which is made to swing from a vertical position to a nearly horizontal one. The drill is attached to a saddle, which is raised or lowered on the standard by means of a ratchet. A catch is provided for fastening the saddle in any desired position. The car moves along the floor without a track, and is fixed in position by means of corner pins, which are driven into the floor and fastened by set-screws. Water is fed to the drill through a flexible hose, which is attached as shown in the picture. The motor and rheostat are attached to the standard.

World's Electrical Congress.

The committee on programme for the World's Electrical Congress has completed its proposed order of business. It will be noted that reference is made to the "general congress" and "chamber of delegates." The general congress will include a smaller body to be known as the chamber of delegates, which will consist of those specially designated as representative delegates from the several governments, appointed for the purpose of considering electric units and their values and making recommendations as to the necessary legalization. The opening session of the general congress will be held Monday, August 21st, at 3 P. M. The congress will be called to order by the chairman of the local committee, Elisha Gray, when the following order of business will be observed:

Election of temporary chairman and secretary, and appointment of a committee to nominate permanent officers will be the first business. The officers will consist of a president; a vice-president for each nation sending delegates to the chamber and a secretary.

Report of this committee.

Short addresses by the president, and by a few of the vice-presidents. Announcements and adjournments.

At the close of this meeting the chamber of delegates will assemble for preliminary organization, which will proceed as follows:

The chamber will be called to order by one of the delegates representing the United States.

Election of a temporary secretary.

Appointment of a committee of five on credentials.

Fixing a time for regular sessions. Adjournment.

At the next meeting of the chamber the committee on credentials will report, and a permanent organization will be completed.

The general congress will be divided into three sections, as follows:

(A) The section of pure theory, including electric waves, theories of electrolysis, electric conduction, magnetism, etc.

(B) The section of theory and practice, including studies of dynamos, motors, storage batteries, measuring instruments, materials for standards, etc.

(C) The section of pure practice, including telegraphy and telephony, electric signalling, electric traction, transmission of power, systems of illumination, etc.

These sections will meet for organization and work at 10 A. M., August 22d. Their organization will consist of the election of a chairman, a vice-chairman, a secretary and a sectional committee of three in addition to the officers named. Temporary presiding officers will be as follows: Section A, Prof. H. A. Rowland; section B, Prof. Charles R. Cross; section C, Prof. A. Graham Bell.

Sections will meet at 10 A. M., on Tuesday, Wednesday, Thursday and Friday, continuing in session at will, except on Friday, when they will finally adjourn as sections not later than 1 P. M.

Each section will have authority to divide into subsections if it is thought to be desirable.

Papers are solicited upon the following subjects, or upon other topics which may be considered suitable in character. They should be sent to the chairman of the programme committee, not later than August 1st. Such as are accepted by that committee, will be put upon the programme of the congress, to be presented in full or by abstract according to the time available.

Magnetic units and modes of embodying them in concrete standards.

Methods of avoiding electrical interference and risks to person and property.

National and municipal testing laboratories.

Materials for standards of electric resistance.

Points of difference of the electrical vocabulary used in different countries.

The direct conversion of the energy of fuel into electric energy.

Comparison of the various methods employed for the electric transmission of power.

The cost of insulation in relation to high pressure for the electric transmission of power.

Comparison of the economies of the various systems of electric distribution.

Alternate current motors.

The behavior of transformers when supplying power to alternate current motors.

The construction of condensers for alternate current purposes.
The measurement of power in polyphase currents.
Direct coupled and non-direct coupled dynamos.
The use of equalizing dynamos in a three and a five-wire system.
The use of accumulators in central stations.
The proportions between output of dynamos and the weight of copper and iron employed in their construction.
Electric traction.
Application of electric power in mining.
The adoption of a uniform method of distinguishing positive and negative mains.
Electric supply meters, American, British, Continental.
Criterion of sensibility of galvanometers.
Commercial instruments for measurement of electric quantities.
The relation between the voltage of the arc and the quality and composition of the carbons.
The aging of glow lamps.
The electric working of metals.
The use of electric and magnetic tests for ascertaining the mechanical properties of metals and alloys.
The best material and mode of erection of lightning conductors in the light of recent researches in electric discharges.
The prospecting for iron by magnetic surveys.

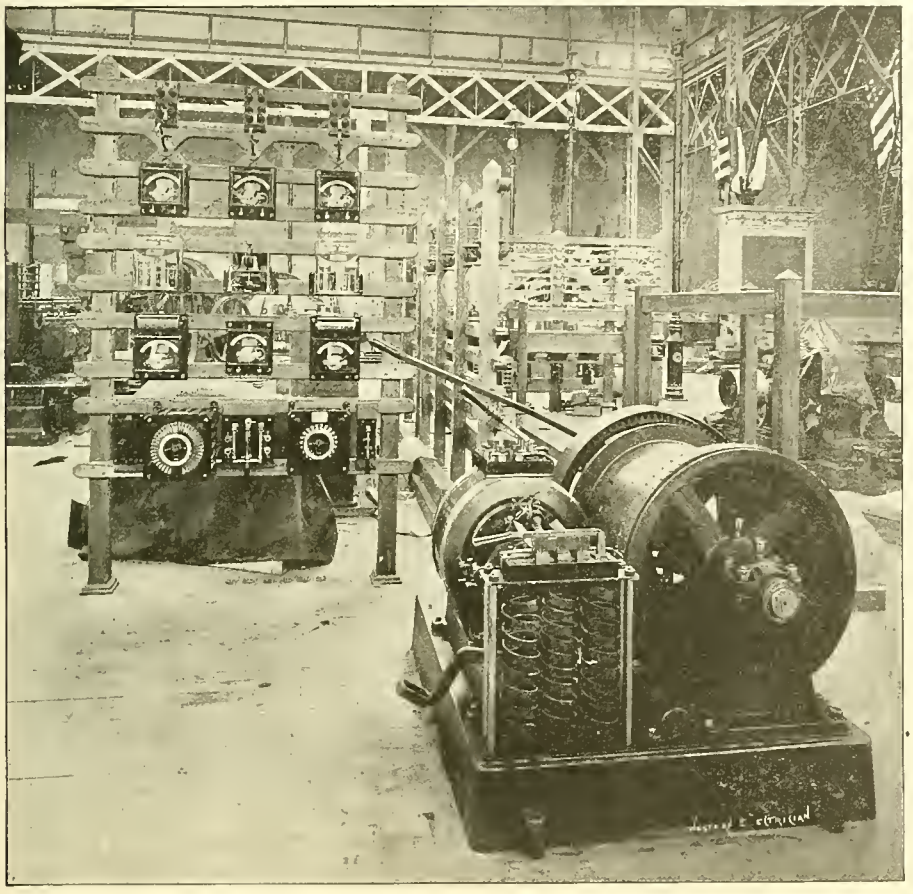


FIG. 3. ELECTRICITY AT THE WORLD'S FAIR.—THREE PHASE MOTOR, DIRECTLY CONNECTED TO HOIST, ELECTRICITY BUILDING.

International telegraphy.
Fast-speed and long-distance telegraphy.
The use of batteries or other generators for telegraphy.
Telegraphic lines—land and sea.
Harmonic telegraphy.
Writing telegraphs.
Long distance telephony.
The possibility of providing telephonic communication without wires.
Application of electric signaling to the working of railways, (alarms, time, etc.,) and to naval and military purposes.
Magnetic separators.
The use of electricity in engraving and in art reproductions.

The time allotted to the discussion of the papers presented will be determined by the several sectional committees. In the discussion of papers the chairman of the section will name the first speaker.

The following topics will be considered by the chamber of delegates, together with such other topics as may properly come before this body:

Adoption of definitions and values of fundamental units of resistance, current and electromotive force.
Adoption of definitions and values of magnetic units.
Adoption of definition and value of the unit of self-induction.
Definitions and values of light, energy and other units.
The standardization of electric lights.
The consideration of an international system of notation and conventional symbols and of a more uniform and accurate use of terms and phrases in electrical literature.
A commercial standard of copper resistance.

The hours of meeting for the chamber of delegates shall be determined, after the first session, by the chamber itself; and it shall also decide upon the admission of persons not delegates to its sittings.

It shall finally adjourn not later than 1 o'clock, on Friday, August 25th, and at the last meeting of the general congress, the officers of the chamber shall report to it a summary of its proceedings and the conclusions reached.

Public lectures of a popular character will be delivered by eminent electricians at 8 o'clock on Tuesday, Thursday and Friday of the congress week. The general congress will assemble to hear reports and for final adjournment at 3 o'clock, Friday, August 25th.

National Electric Manufacturing Company Asks for a Receiver.

Proceedings were taken in the Circuit Court last week by which the National Electric Manufacturing company's plant at Eau Claire, Wis., passed into the hands of a receiver.

The event caused a sensation so far as the public is concerned, but the matter has been under consideration for some time. An action had been brought by James T. Barber et al. against the National Electric Manufacturing company, the complaint in which sets forth that the company was embarassed by very pressing claims on the part of creditors which it was unable to pay; that the large plant and valuable business of the company could best be preserved in their entirety for the benefit of all concerned, by by the appointment of a receiver.

Mr. Hayden, attorney for the plaintiff, requested the appointment of Ralph E. Rust as receiver, bond being offered in the sum of $50,000, with William A. Rust, John S. Owen, James T. Barber and Fitch Gilbert as sureties. Judge Bailey made an order appointing Mr. Rust receiver.

Although the company, by reason of the general financial stringency, has been considerably embarassed, the conditions are such that under the receiver the business can and will be carried on without any interruption whatever. There will be no stoppage and a reorganization will probably be effected within a very few days.

The company's plant it is claimed is worth $300,000; there is a large amount of valuable manufacturing products on hand, and there are also large outstanding orders. The assets foot up between $500,000 and $600,000; the liabilities are about $300,000.

Electric Heating.[1]

By Carl K. McFadden.

The fact that an electric current when passing through a resisting conductor will generate heat has been known for years. During the past thirty years it has been applied to an ever increasing extent in the manufacture of heating devices used in almost an unlimited number of ways. It remained, however, for the electric street railway to open up the field for heating. The fact that there has been issued during the past two years and a half over eighty per cent. of the total number of patents on heating devices shows conclusively that the influences which have have made themselves felt during the past few years in the general development of electrical apparatus have not left heating behind in the list of improvement.

The first patents issued on electric heaters were taken out in the fifties, and a few years later several were taken out on an oil well heater for melting paraffine and other obstructing material from the bore of oil wells. It appears that after oil has been flowing from a well for some time a large accumulation forms at the bottom which, unless removed, will lessen or completely cut off the supply. Nitro-glycerine was the agent usually employed to loosen up these deposits, but it would seem that an electric heating device in the form of a pointed elongated cylinder would melt out the obstruction, and that this method was used to some extent in the oil regions of Pennsylvania. Patents taken out between 1860 and 1870 show that the idea of placing an electrical conductor in contact with an insulated heat conductor having a relatively lower radiating surface than the electric conductor had been thought of and applied in a number of ways. Burton being probably the pioneer in this class of work. In the patent specifications filed, however, about this date, platinum is spoken of as a conductor, it evidently being thought necessary to raise the wire to quite a high temperature and, therefore platinum was chosen on account of its high melting point.

There are to day in the neighborhood of 150 patents on electric heaters, which alone goes to show that considerable attention has been paid them by the inventors. A very large number of these patents apply to the heating of cars. One of the earliest applications for patents on electric heating apparatus, filed in 1869 by Burton, specifies that one of the largest applications of this particular heater, for which a patent is applied, was that of "heating railway carriages by means of heated metallic plates placed under the feet of passengers." Among the many patents issued will be found some that would seem extremely impractical, one of which is the utilization of a heated platinum wire for cutting down trees, etc, the object of the invention being, as the inventor expresses it, "to accomplish the same ultimate result as that now obtained by the more laborious use of the ax."

There are other patent drawings showing a locomotive whose boiler tubes are filled with a heating device for generating steam. An electric generator is placed on the tender and from appearances would lead one to suppose the generator was to furnish current to heat the water in the boiler, which would generate steam to drive an engine which would be connected with the dynamo, and that the locomotive, therefore, not only moved the train, but also charged the batteries to some extent.

There are a great many other inventions, however, that are extremely practical, and as this branch of work progresses will, no doubt, be brought out and become marketable articles.

To one who has not investigated the remarkable differences in the carrying capacity of a wire when provided with various means of radiating its heat, it will appear astonishing to see a wire carrying safely several times the current that would fuse it in open air. The principle of all well known heaters, is that of placing a good heat conductor, having a large radiating surface, in intimate contact with the electric heating conductor, and there is little doubt, that, inasmuch as nearly all serviceable heaters depend upon this principle, the advantages of one make over another will be more in the line of mechanical details in construction than in efficiency. If the heater is made unusually heavy and contains a large amount of heat conducting material, it will reach its final maximum temperature much slower than one that is built with its heat conductor or reservoir of lighter and thinner material. It may appear immediately after starting both heaters that the latter is more efficient, but if the amount of energy taken up and the radiating surface is the same in both, it will be found that although the heavier heater heats much more slowly than the lighter one, it will hold its heat and remain in a highly heated condition for a longer time after the current is turned off than the lighter heater.

As before mentioned, the electric railway opened up the field for electric heating, the first Sprague road in Richmond, Virginia, being equipped with electric heaters. It has been shown many times that the cost of operating electric heaters on electric roads stands on a par with coal when consideration is made for the value of space that the coal stove generally takes. The electric heaters are generally placed in four or more places in the car, where they will be out of the way of passengers when seated, and in such a position that they will at the same time throw their heat into the body of the car. There has been considerable discussion in regard to the amount of current necessary to keep a car warm in cold weather. Reports from roads operating in Northern Michigan and in other portions of the United States and Canada, where the winters are unusually cold, show that from 1,200 to 1,500 watts is sufficient current to keep the average sixteen-foot car warm in all kinds of weather. It will be seen that inasmuch as the heaters require no attention whatever and are practically a fixture of the car that the cost of maintaining and operating on the average electric road will be simply the cost of current. Coal stoves take from twenty to forty cents per day to operate, if the least account is taken of

1. Read before the Chicago Electric club, May 15, 1893.

time used to keep them in heating condition. The coal stove also take up room for one or more passengers while it remains in the car, which, on a road doing a good business, is a very important item. Coal stoves, too, on cold days, when being heated unusually warm, become so hot that it is often impossible to stand immediately in front of the stove without burning the clothing of the person standing near. Twice within the last few months it has come within my notice that the tops of coal stoves, such as are used in electric cars, are generally in a condition to burn clothing. It is a very natural thing for a man to lean against the guards around the top of these coal stoves, and it generally results in a tailor bill, which, although the railroad company may not have to pay, at the same time is nothing in favor of a stove necessarily run at a temperature which will burn wearing apparel.

The electric heaters being placed under the seats out of the way, and furnishing a lower temperature, cannot be objected to on this score, and being entirely out of the way of passengers, and taking up no space in the car which can be utilized to bring in dividend, often saves in a day more than the entire cost of the current furnished them for the day's run.

There are many times in spring and fall when the mornings and evenings are cool and the middle of the day warm, when a heated car for a few hours each day would add greatly to the comfort of passengers. With coal stoves this is often impossible, unless the car can be taken out of service long enough to have a fire rebuilt in the stove. The many testimonials received from the officials in charge of some of the largest roads cannot leave one in doubt as to the way the public appreciates this method of heating.

If we assume that the only cost of running electric heaters is that of the extra amount of coal burned at the power house, there is no opportunity for argument as to the cheaper method of heating electric railway cars, even when not taking into consideration the convenience and gain in car space by the use of electric heaters, but if the engineer's time has to be figured in for additional attention to engines and dynamos for current for electric heaters, why not figure in a portion of the conductor's time, who oftentimes is called on to take care of his stove while on the run, even though a man be stationed at the terminal point whose special business it is to oversee the heating.

The total cost of one net horse power at the engine on a plant with an average output of 500 electrical horse power is about six-tenths of a cent per hour. The cost of an electrical horse power hour will be found in this same plant to be about one cent. It will be seen from these figures that the total cost of operating electric heaters will be in the neighborhood of two cents per hour.

I believe that it is just as fair to both sides of the question to assume that the fireman and engineer will not be called on for nearly as much additional work to furnish current for electric heaters as the street car conductor and other helpers whose time is wholly or partly taken up in attending to coal stoves. On one road which has come under the notice of the writer a man is paid $1.50 a day to take care of stoves on fourteen cars. This man has no other work to do, with the exception of oiling a few switches near his work. I understand that the man works twelve hours a day and that the cars run twenty. We may assume that there is at least from 10 to 15 cents a day spent in labor in tending these stoves, the conductor's time not being included. The cost of coal in such a stove will be in the neighborhood of 20 cents when operating twenty hours a day, at coal at $8 per ton. The stove used is open to the same objections that all coal stoves have on electric cars. I assume that electric heaters on these cars could without doubt lower the cost of heating. Under the conditions as they now stand on this road the cost of heating during the past winter was far less than in the preceding winter. In many instances coal has to be carried from the power station or some other point to the terminus of the line where the cars lay over before starting on their trips. This hauling should be taken in as an item of expense connected with the use of coal stoves.

Street railway companies seldom take account of the cost of operating the two series of incandescent lamps usually found in lighting street railway cars. This lighting takes at least one third of the energy which might be used for heating.

In a great many estimates which have been made in regard to the cost of coal stoves on electric roads, items have been left out which, when added to the cost of the coal, will bring the actual cost of heating a car on a cold winter day at about the figures to heat the same car by means of electricity. The average life of a street car stove is about three years, and the repairs on even the best make of stoves will be found to amount to a considerable sum before the stove is ready to be abandoned. It also takes time to put these stoves in position and to remove them at the end of the season. It is a well known fact that there are few cars heated by means of stoves that do not have a layer of dust deposited in the car each time the stove is filled or shaken.

A deposit of ashes and coal dust five or six times a day on a finely upholstered car soon starts the foundation for an upholsterer's bill, which, of course, on a road equipped with electric heaters should be a smaller item of expense than on a stove heated road.

Much has been said in the past in regard to burn-outs and other difficulties which occur in the use of electric street car heaters. I believe, however, that with the experience gained in this line by those who have made this branch of work a specialty, the failures from such causes as have made trouble in the past will be practically unheard of in the future.

It is by no means an unheard-of thing for a coal stove to set barns or cars on fire; a thing which with a properly installed electric heater would be impossible to occur. When properly installed they can not possibly injure wood work in the car by excessive heat. There are few street railway companies using stoves for heating that do not find the cost of extra finishing and painting each year, caused by scorched varnish and wood work around the stove pipe as it leaves the car, to be such as to make quite an additional item to the maintenance of car bodies.

Where power is cheap and coal is dear, which is a condition often met with in mountainous districts supplied with water power, electricity will necessarily play quite a part in heating.

A Pelton water wheel when running under a large head of water, such as is met with in the western mountainous districts, can be harnessed to a little mountain stream and develop enough current to heat and furnish power for a small factory with practically no cost, except attendance and depreciation of cost of machinery.

Under such conditions as these electricity could be used to great advantage for heating purposes, even quite a distance from the generating station. There are other places in the West where power is guaranteed the year round at $10 per horse power from turbines. These figures may, of course, be exceptionally low compared with water power in the Eastern states and, at the same time, I might say that there are many places in the West where even $10 per horse power would be considered a high figure, power being obtained the year round at from $6 to $9 per horse power, delivered at the turbine. Many mines in the West are equipped with large water powers and could use electric heating to great advantage in keeping certain exposed portions of the power plant at a comfortable temperature. This branch of work has been taken up to some extent already and, inasmuch as the mine equipped with water does not depend on coal for its motive power, any coal used for heating would cost even more in the quantities in which it would be purchased than if it was used by the mine for steam generation. In many mines, too, it is out of the question to put in heating apparatus which gives out any gases which might be injurious to the workmen. In a vast majority of cases it is of course, impossible for this reason to use a coal stove, and entrances to mines and other exposed places down in the mine itself are not heated because it is considered an impossibility.

Since electric heating has been taken up so successfully on electric roads, the fact also presented itself that there would be a large field in cooking devices to be operated by currents of standard voltages to-day used in lighting. A few electric stove companies have at present good lines of cooking utensils, which surely fill every want for reliability, cleanliness and good design. There are many cases, especially in the smaller size cooking utensils, where electricity can compete with coal. A small tea kettle taking 250 watts of current will furnish boiling water in a few moments by the simple turning of a switch. An "afternoon tea" can be given, the cost of current being but a few cents. There would be no need of fires being lit with the necessary dirt and attention; but the cooking utensils could be placed, you might say, on the parlor table with no visible connection to a source of heat with the exception of a silk-covered conducting cord. The use of electricity in the kitchen reduces the art of cooking to a science. It is an easy matter to determine just how many minutes it will take to cook a certain dish with a current of a certain predetermined strength. This method leaves nothing to be guessed at and, of course, the current may be cut off and all expense stopped the instant that the cooking is completed. With coal stoves this is an impossibility and fires have to be started long before you are ready to use them and the waste of fuel goes on even after the work is done. It would be a pleasant thought on winter mornings for the lazy man to know that his kitchen fire was a thing of the past, and tha the fire that would cook his morning meal had been started long before in the power house, it being only a question of throwing a switch and waiting a minute or so for his electric culinary apparatus to be in condition for cooking. The exact pecuniary value of his comfort thus obtained is, of course, mere conjecture and would have to be answered by the man in question.

There are, of course, a vast number of plants throughout the country that will not furnish current at a rate which would allow electric cooking apparatus to be used, provided it was simply a question of coal costing so many cents per hour and electricity a few cents more. There are advantages in the use of electricity for both heating and cooking which must not be ignored. There are a great many places where electric light costs more than gas, and still it is the modern illuminant. It has advantages which gas has not and the public is not slow to take advantage of them, and for this reason more than any other there are few towns of any size that do not have their electric lighting plant, even though a gas plant has already been installed.

For the heating of chemicals and other applications where an exact amount of heat is needed electricity possesses more advantages than any other method of heating, and there is no doubt but that in this particular line electricity will be used to a large extent. For heating water in drug stores, buffets, etc., electricity also should take quite a part. For heating offices and other small rooms in buildings not equipped with steam, electricity, even at current rates of power service, will be found to be far less expensive than one would at first suppose. An office heater, capable of warming a fair sized room, will be found to be not only an extremely satisfactory way of heating from a sanitary point of view, but will, of course, be entirely free from all gases or odors which are inseparable from the gas or coal stoves.

In conclusion, I would say that the field for electric heating seems to be on the eve of development in a sense that will be a surprise to even those laboring in this branch of work. The general public cannot remain long in ignorance of advantages of this method of heating, and although there will be many places where electric heating is an impossibility from a practical standpoint, there will still remain an immense field in which the electric heater will take a firm and permanent hold.

FIG. 4. ELECTRICITY AT THE WORLD'S FAIR.—EXHIBIT OF DAY'S KERITE, ELECTRICITY BUILDING.

The Lamp Situation.

The latest development in the incandescent lamp controversy is the arrangement between the Sunbeam company and the General Electric company amicably settling the litigation between these concerns. By the terms of this agreement, it is understood that the Sunbeam company and its customers are released from all claims for past damages and are relieved from an accounting. It is also claimed that the Sunbeam company will be permitted under the provisions of the agreement to dispose of the stock on hand, including lamps and material, thus practically closing up the business of that concern, as the arrangement does not provide for a continuance of the manufacture and sale of lamps. The agreement between the Sunbeam and General Electric companies does not in any way affect the Star Electric Lamp company, it is said, and the latter company will continue the manufacture and sale of the "New Sunbeam" lamp. Possibly this arrangement marks the beginning of a new policy on the part of the General Electric company toward the other lamp manufacturers.

Death of Moses G. Farmer.

The entire electrical fraternity will read with genuine regret the announcement of the death of Moses G. Farmer at Chicago, May 25th. Prof. Farmer had attained the age of seventy-three years and enjoyed the reputation of being one of the pioneers in the field of theoretical and applied electricity. In spite of his advanced years he was ever alert to the progress that was being made in his favorite and chosen profession and this fact brought him to Chicago, that he might be nearer the great electrical display at the World's Fair, to which he was a contributor. He made Chicago his temporary home last October and was so delighted with its advantages that he resolved to remain permanently. Although a confirmed invalid and confined to an invalid's chair, for he suffered a stroke of paralysis in his left side five years ago, his mind was most keen until the last. The immediate cause of his death was pneumonia, induced by a severe cold contracted a few days before his death. The portrait presented is reproduced from one taken a few years ago and which is considered an excellent likeness.

As a man he was beloved by all who knew him. Of a philanthropic disposition, he spent the greater portion of his income for benevolent objects, and of his kindly disposition many remain to speak with gratitude.

His wife was also known for her practical charities. She endowed a home for mothers and children at Eliot, Me., the Farmers summer home, and with the aid of Prof. Farmer erected a public library in the town. As a scientist, in electrical investigation, it may be said that he was a man ahead of his time. To him is generally awarded the honor of having made the first motor capable of moving a car. He exhibited it on the first electrical railroad known, but it was considered impracticable because of the great expense attending the production of the current by means of batteries. As a scientific toy, however, it attracted considerable attention, and it was first placed on exhibition at Dover and Great Falls, N. H., and at other New England towns and finally at New York. The car was propelled by forty-eight cells of Grove's battery, connected in series and inclosed in a box. In front of this battery box on the car was the electric motor. Although of the most primitive design and construction, it embodied the underlying principles of the motor of to-day.

Subsequently it is claimed for Prof. Farmer that he amazed his neighbors by lighting his house with electricity and in 1852 he invented, made and regularly used an electric cooking stove, whereon he broiled his steaks and chops, during his residence in Boston. However, the most important of his inventions were the fire alarm system, which with some modifications was adopted by Boston and which it retains to the present day, and the solving of the problem of multiple transmission. These discoveries illustrate the inventive genius of the man and the capacity for research which he possessed.

Although the son of a well-to-do farmer and lumberman of the little town of Boscawen, N. H., he was in the strictest sense of the word a self-made man. He began life as a teacher and early developed his inventive qualities. He took up the study of electricity and soon became identified with the projectors of the telegraph line between New York and Boston. After several years in this line of business he was appointed, as the result of the introduction of his system, the superintendent of the Boston fire alarm service, an office which he filled until 1853, when he resigned. After devoting some time to the developing of his electrical ideas, he was induced to become a partner in an electrotyping enterprise. In the financial panic of 1857 the firm lost most of its capital and dissolved. He was selected in 1872 to fill the office of electrician at the United States Torpedo Station, Newport, R. I. He remained in this position over nine years, until in 1881 his health failed him. Despairing of finding relief he settled in Eliot, Me., where he lived until last October.

Although enfeebled in body his mind retained its vigor, and as late as 1891 he secured patents for a system of printing telegraphy in the United States, England and other countries, his intention being to exhibit it at the World's Fair.

Of Puritan parents, through life he was always a constant attendant at the Congregational church. He was a brother-in-law of C. C. Coffin, the war correspondent and author.

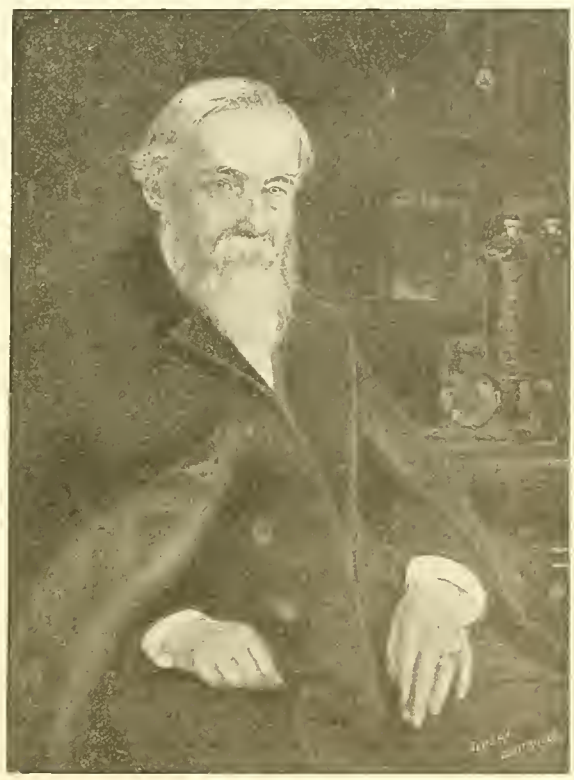
An only daughter, who faithfully acted as nurse, aid and amanuensis during his illness, survives him. The funeral services were held Monday last at the church of Edward Everett Hale in Boston and the burial followed at Eliot, Me.

Charged With Criminal Libel.

The grand jury of New York has returned an indictment against B. E. Greene of New York, charging him with criminal libel in publishing an article in the issue of *Electricity*, dated May 17th, under the title: "Mr. Coffin's Admissions.—The General Electric Company Has Failed to Meet Some of its Obligations Promptly, and is Not in Easy Financial Condition."

The article purported to be correspondence between a director of the General Electric company and President Coffin of that concern, in which the former interrogated the latter about the condition of the company and its management. In Mr. Coffin's reply as printed in the article in question it is complained that the word "first" should have been "fifth." As printed, Mr. Coffin is made to admit that the company has been disturbed in loans and refused accommodations, and that it has failed to meet obligations promptly, whereas, if he had been correctly quoted, he would have been represented as answering that the "company is in perfectly easy financial condition." It is claimed on the part of the General Electric company that the change was made with the intention of conveying to the public a wrong impression of the company's financial condition. It is claimed that the correct version of this letter had appeared several days before in the daily papers.

Concerning the case, Mr. Greene of *Electricity* says that



MOSES G. FARMER.

the entire article as it appeared in his paper was copied from a daily paper, and that his intention in reproducing it was merely to present the facts as he understood them to be. Mr. Greene has been admitted to bail in the sum of $1,000.

Gas Engines for Electric Lighting.

In a communication to the London *Electrician* J. A. McMullen says that, as consulting engineer, to two central stations about to be put down, he is endeavoring to procure a type of gas engine which will be steady enough to work alternators in parallel, even at light loads. Discussing the present types of gas engines on the market the correspondent says:

For this purpose the single-cylinder, single-acting type of engine, working on the Otto cycle, governed by cutting-out explosions, is manifestly unsuitable, and gas-engine manufacturers who are simply relying on high speeds and heavy fly wheels are clearly not on the right road to success. It is possible in central stations of small size to arrange for the mechanical coupling of the alternators, but this would probably be found impracticable on a large scale. For working alternators, even of the best type, in parallel it is certainly necessary that each engine should have at least two impulses per revolution.

Totally regardless of this, most of the chief manufacturers advertise their single-cylinder, single-acting engines as perfect for dynamo driving, thereby utterly ignoring that system of electrical distribution which is more used than any other, and which these so-called perfect engines are totally incapable of driving successfully. There is but little difficulty with direct current dynamos helped by accumulators, but gas engine manufacturers are very blind to their own interests if they continue to ignore alternating current working, as they are at present doing.

Even for direct currents, high speeds and heavy fly-wheels are a disadvantage, for they mean excessive wear and tear and liability to break-down, which should be avoided if possible. Could the difficulty of stuffing boxes be overcome (and one firm appears to have succeeded in this), the adding of an extra single-acting cylinder tandem fashion would give one impulse per revolution, and would double the power of an engine without increasing the size of its connecting rod, main bearings and other parts in front of the cylinders. Two such tandem engines coupled would give two impulses per revolution. A twin-cylinder, double-acting engine gives two impulses per revolution, as would also a tandem engine with double-acting cylinders. This latter type would have great advantages. The connecting rod, main bearings, etc., need not be larger than those for an ordinary engine one-quarter the size, so the engine should be a cheap one in capital cost, and should have a high mechanical efficiency.

This difficulty of stuffing boxes seems to me capable of solution by passing cooling water through the piston rod. I can imagine several ways in which this could be arranged. It is certainly in the direction of quadrupling the number of impulses that manufacturers should work, if they wish their engines ever to be used in alternating current central stations. Not only this, but governing down to at least half load must be performed by varying the power of explosions, and not by cutting them out altogether.

Boynton Bicycle Road.

The members of the Thomson Scientific society of Lynn recently entertained Hon. E. Moody Boynton, who talked to the members about his bicycle railway and its operation by electricity.

The question of questions at the present day is rapid transportation, said Mr. Boynton. Economy is secured by water routes where the cost is seldom more than one mill a ton per mile, but the demands for more rapid transportation seriously threatens the supremacy of the water routes. To-day Boston and the principal cities of Europe and America are as devoid of rapid transit as Egypt at the dawn of civilization. The light engine of Ericsson and Stephenson, which could run as fast as the average train now runs, has been increased in weight until we carry 20 pounds of timber and iron in palace cars and 10 pounds in crowded ordinary cars to every pound of paying weight of passengers carried. On long routes across the continent the weight and waste are so enormous that national railroad bankruptcy is threatened, unless the present extravagant system is changed. But in order to keep the track at high speed efficiency and to obtain the necessary boiler and engine power, weight has been increased, rails, bridges and roadbeds made heavier, until all the great thorough fares are capitalized so heavily that they can be paralleled at one-tenth their cost and entirely swept away by electric rapid transit.

The capital of the railroads of the United States many times exceeds that of the national and savings banks. Any impairment will bring on a financial convulsion and possibly a revolution. I believe that the controllers are conscious that a great change is pending. These roads are banded together and all individual building of steam railroads has ceased. The use of the single rail for the passage of trains on standard gauge railways has been my especial study. We constructed near New York an experimental railroad out of an abandoned standard gauge road so that no practical engineering should go without attention. It was an old surface road elevated for one mile and surface for three quarters of a mile. The curves were so many that it had been abandoned and stage coaches substituted. At an expense of $100,000 we repaired it and equipped it with my single rail bicycle engines and cars, and in three years we have run 27,000 trains, carried 100,000 passengers safely, smoothly and at three times the speed of standard gauge engines. With an expenditure of five pounds of coal per mile we move three cars containing seats for 324 passengers. I used veneer and steel in the construction of the cars, each of which contains 18 compartments seating six persons each. They are entered from the side like a hack. One brakeman opens and closes the doors of two cars by a lever without leaving his position. Not an accident of any kind has taken place in the three years. These cars are stiffer and stronger than any others, on account of their compartments and special construction with steel and veneers. Where the sheets of the veneer come together in the compartments no strain is observed in stopping the train when running 70 miles an hour. There has been scarcely any wear and tear of the working parts when rounding the sharpest curves. Electricity should be used. If electric energy from coal is between 40 and 50 per cent if applied electrically, and 80 per cent by steam, the difference will be more than made up by the saving in weight. My largest engine contains an eight foot driving wheel with a 14 inch stroke. Nearly two strokes are made to the present ordinary 11 ton engine's one. My first bicycle electric motor car has wheels five feet in diameter, turning on spindles, one at each end of the car, which is sharpened to cleave the atmosphere. The field and armature are in and on the wheel and it can turn the sharpest curve. If a road of sufficient length were completed the first motor could run at the rate of 200 miles per hour.

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CORRESPONDENCE relating to electricity, or anyof its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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VISITORS

To the World's Fair are requested to forward their addresses to the WESTERN ELECTRICIAN as early as possible or notify us immediately upon their arrival in Chicago.

AT last three evenings a week—Tuesday, Thursday and Saturday—have been officially designated by the authorities of the World's Fair as occasions on which "special evening entertainments" will be given and the grounds thrown open to the public until 11 P. M. This is good as far as it goes, but we are at a loss to know why the directors, while they were about it, didn't extend the rule and make it include every week-day evening. We are hopeful that this will ultimately be done, however, to the great satisfaction of the public generally and in justice to those engaged in making the electrical display.

AS THE time draws near for the gathering of electrical scientists from all parts of the world at Chicago to participate in the World's Electrical Congress, there is a general awakening of interest in the work to be presented to the delegates. The proposed programme, which is presented elsewhere in this issue, will be read with interest. In this connection the article appearing on another page, in which E. Hospitalier discusses several propositions which are offered for the consideration of the congress, is timely. No doubt the views presented will receive the careful consideration of the delegates.

ONE by one the pioneer investigators who delved in the field of applied electricity in the first half of the century are dropping away. The latest to lay down the burden of life is Moses G. Farmer, some account of whose achievements are given on another page. Mr. Farmer was a faithful and conscientious worker in the field of electricity, and many of his inventions have permanent value. He was notable for his efforts to produce a practical electric motor, and forty years ago he succeeded in running a car by a motor which does not differ greatly in principle from the motors in use to-day. Mr. Farmer leaves behind him a record of achievement that should serve as an inspiration for many an ambitious young electrician.

THE commanding proportions and graceful outlines of the "tower of light" in electricity building, illustrated on the first page of this week's issue, will linger in the memory of the visitors to the exposition as one of the most fascinating spectacles in that great aggregation of wonders known as the World's Fair. With its five thousand colored lights, presenting changing designs in outline and color, and the great crystal lamp surmounting all and flooding the atmosphere with sparkling, iridescent light reflected from many thousand facets of cut glass, the sight at night cannot fail to make a lasting impression on all beholders. The department of electricity is to be congratulated on the possession of such a beautiful and striking display.

ELECTRIC heating forms the subject of paper presented in this issue in which the topic is pretty thoroughly discussed. It seems to be the general opinion that the advantages of this form of dispensing heat will in many cases overcome the objection which is based upon the expense of installation and maintenance. There is no doubt that in many cases this cost may be materially lessened by improvements in apparatus, etc., and where current is furnished for light and power as well as heating, the manifold advantages of the system will quite off-set the additional expense. But the advocates of the system are not content with this. They claim that electric heating will be quite generally introduced, that improvements in the devices and new forms of heaters will make the application much more economical, and that the history of the development of electric lighting will be repeated in the case of the electric heater. It is to be hoped, however, that the projectors of the electric heater will guard against the error which their predecessors made. Extravagant claims by irresponsible salesmen of electric lighting apparatus in the early days of the art caused no end of trouble for those who followed. Even to-day the prejudice against electric light and power apparatus is often displayed by those who were so unfortunate as to be the victims of the exploiters of the pioneer systems of electric lighting. In view of the experience gained in electric lighting and the electric railway, it is to be hoped that the projectors of heating apparatus will follow a conservative policy. Thus far they have been content to present only such claims as might be substantiated by data of authentic experiments. The electric heater will undoubtedly win its way into public favor if this course is followed.

INVESTIGATION of the charges recently preferred against ex-Commissioner Simonds, of the Patent Office, and Foster & Freeman, attorneys for the American Bell Telephone company, has been commenced at Washington. It will be remembered that the allegations were in general that through the connivance of Messrs. Simonds, Foster and Freeman and Chief Clerk Benoett copies of certain records in the Drawbaugh telephone case, presumably in the secret archives of the Patent Office, had been unlawfully inspected and copied by persons outside of the office in the interest of the Bell Telephone company. Immediately upon the publication of the charges the attorneys mentioned in the complaint entered an emphatic denial of the charges and expressed a willingness to co-operate with the government in bringing the case to speedy trial. Mr. Simonds' denial is no less emphatic. Concerning the specific charges that have been presented against him the ex-commissioner says in his defense:

> This complaint makes specific mention of copies given of only two Drawbaugh applications, one filed in 1880 and the other filed in 1884. If both had been pending applications, it would have been no offense in law or good morals to have given copies of them. So much the courts have decided. But as a matter of fact the whole matter was treated in strict accordance with the rules of the office. The 1880 application was not a pending application; it was a dead and abandoned application, and a copy of it was properly given under rule 179 and form 52. The 1884 application was treated as a pending application and the copy was denied. My decision is published in the *Gazette* of April 4, 1893.

He pronounces the other charges "false, outrageous and defamatory both in substance and in detail." The attorney-general has notified the commissioner of patents that owing to the pressure of public business it will be impossible for him to delegate an officer of his department to conduct the investigation. This is certainly to be regretted. The investigation should be conducted under official sanction and by representatives of the government, and access to records of the Patent Office should be had in order to make the inquiry complete and the decision final. The people are interested directly in this investigation, the standing of a powerful corporation conducting a public business and enjoying peculiar privileges under the government is affected, the reputation of prominent attorneys and a former official of the government is attacked. But above all and of paramount importance is the fact that the integrity of an important branch of the public service is brought into question. In view of these facts it would appear that the attorney-general should take cognizance of the proceedings and give the investigation an official character. If the charges are sustained and if it be shown that the Patent Office has been used unlawfully, the public should know the facts and the department thoroughly reorganized; if, on the other hand, the charges cannot be sustained, the acquittal of the persons against whom the charges have been preferred should receive official endorsement and be given all the weight that this implies. At any rate the investigation should be conducted thoroughly and with expedition.

SUPPLEMENTARY consular reports received at Washington recently furnish additional proof of activity in several lines of electrical work abroad. The latest advices from Berlin announce that public interest at the German capital is centered in the experiments conducted by two Belgian scientists who are developing a system of electric heating and welding and the refining of metals by electricity. Messrs. Lagrange and Hoho in March last exhibited their new system of welding in practical operation before the Electro-technical Society of Berlin and, according to the United States consul whose report describes the experiments, the demonstration was thoroughly satisfactory. The apparatus employed is described as consisting of a "glass or porcelain vase provided with a lining of lead connected with a strong conductor of positive electricity. The vase is filled to three fourths its capacity with acidulated water. A pair of iron tongs with insulated handles is attached by a flexible conductor to the negative pole of an electrical current generated by an ordinary dynamo." With this equipment the following phenomenon is produced: "The electrical current having been switched on, a bar of wrought iron or other metal is taken up with the tongs and plunged into the water within the vase. Immediately the water begins to boil at the point of contact; the immersed portion of the iron rises quickly to a red, then to a white, heat, and emits a stream of brilliant white light. In a few moments the heat becomes so intense that the iron melts and falls off in bubbles and sparks, leaving a clear, glowing surface in perfect condition for welding. The heating process has been so rapid that neither the water nor the end of the bar held within the tongs have been more than slightly warmed, and, the current being switched off the bar with its submerged end glowing, may be held in the naked hand." It was estimated at Berlin that fully fifty per cent. of the current was directly utilized as heat. There are many advantages claimed for this process, which, of course, can only be determined by practical application to commercial work. It is said that Krupp & Co. have become interested in the process and have established an experimental plant at their works.

Another interesting report is presented by the United States consul at Buda-Pesth, who describes the operation of the electric railway at that point as giving satisfaction to the people. It has now been working three years. Seven miles of track, upon which sixty cars are operated, are equipped with an underground conduit system. It is noted that the only interruption in the service was caused by unusually heavy falls of snow.

From Pekin the United States minister furnishes some interesting facts about the Chinese land telegraph system, which has been joined to the Russian system. The Chinese system now reaches Helampo in the north, where the connection is made with the Russian lines; Aichow, in Hainan, in the south; Wenchuen, in Kirin, in the northeast; Takao, in Formosa, in the southeast; Suchan, in Kansu, in the northwest; and Zengyueh, close to the Burmah frontier, in the southwest. The only province which is not reached by telegraph is Hunan, which still remains opposed to all foreign innovations. There are 147 stations scattered throughout the principal provinces. The service is satisfactory, but the rates are still very high, and this probably explains to a great degree the fact that the telegraph has not yet come into general use.

On the whole the reports are extremely interesting to Americans, particularly at this time, when the entire world is afforded an opportunity to compare American methods and apparatus with those of other countries.

Propositions for the Consideration of the Electrical Congress.[1]

By E. Hospitalier.

As a sequel to the article published in our last issue[2] on the rules of electrical nomenclature, we present herewith a table which groups the principal physical quantities that interest electricians, the symbols which we propose to represent them in formulæ, the defining equation of each of these quantities, the dimensions of each in the C G. S. system and in addition the names of the C. G. S. units and the practical units used to designate them. We could wish to have added to the table two special columns for fundamental and practical standards; but this matter, from an international point of view, involves such difficulties that it has seemed prudent to reserve it.

Fundamental Quantities and Units.—Despite therecent excellent works of Ruecker, Ostwald, Williams and others there is no reason to modify the system of C. G. S. magnitudes and units adopted by the International congress of 1881, and expanded and completed by subsequent congresses.

Geometric Quantities and Derived Units.—No change or addition is proposed. The names, definitions, units of fundamental magnitudes, and of geometric magnitudes of the C. G. S. system are so well known that it seems useless to reproduce them in the table.

Mechanical Quantities and Derived Units.—No change is proposed, but a single addition is suggested which relates to a physical quantity frequently appearing in calculations upon dielectrics and magnetic phenomena. This quantity is the ratio of an energy to a volume. We propose to call it volumic [volumique] energy in order to suggest its origin from the two quantities which appear in its definition. It is equivalent to a pressure and may be designated by the same symbol (p). Its C. G. S. unit is the erg multiplied by the cubic centimeter.

Magnetic Quantities and Derived Units.—We propose an addition as a designation for a quantity called specific magnetism and defined as the ratio of the magnetic moment of a magnet to its mass. There should be created a special symbol if the practical use of this physical quantity is to be extended. Reluctance is the name proposed as a substitute for the expression "magnetic resistance," and the corresponding coefficient will be reluctivity. These two terms correspond to resistance and resistivity. To be logical the word permeance, corresponding to conductance, must be adopted, and permeability, which is today universally adopted, should be preserved; there seems to be no reason to change it to inductivity. Permeance is the converse of resistance and reluctivity the converse of permeability. We propose the adoption of these expressions suggested by Guillaume, as their logical formation has the advantage of introducing method in the coinage of new expressions.

Electrical Quantities and Units.—In accordance with the suggestion of C. E. Guillaume there is reason for the systematic adoption of the termination "ance" for physical magnitudes which do not constitute properties of matter and which vary with mass or dimensions, and for reserving the termination "ity" for properties of matter. Specific resistance then becomes resistibility or resistivity; conductivity the converse of resistance, becomes conductance, and what is called specific conductivity is simply conductivity. In carrying these changes to the extreme limit, the name capacity would be applied to what has been called hitherto dielectric constant inductive capacity or specific inductive capacity, and actual capacity would assume the name of capacitance.

TABLE OF THE PRINCIPAL SYMBOLS OF PHYSICAL QUANTITIES AND ABBREVIATIONS OF UNITS PREPARED FOR THE ELECTRICAL CONGRESS.

Physical Quantities.	Symbols.	Defining Equations.	Dimensions of the Physical Quantities.	Names of C. G. S. Units.	Practical Units.	Abbreviations of the Practical Units.
Velocity	v	$v=\frac{L}{T}$	LT^{-1}	Centimeter per second.	Meter per second.	m/s
Angular velocity	ω	$\omega=\frac{v}{L}$	T^{-1}	Radian per second.	Revolutions per minute.	t/m
Acceleration	A	$A=\frac{v}{T}$	LT^{-2}	Centimeter per second per second.	Meter from second to second	m/s²
Force	F	$F=M.A$	LMT^{-2}	Dyne	Gramme; Kilogramme.	g; kg
Energy or work	W	$W=F.L$	L^2MT^{-2}	Erg.	Kilogrammeter.	kgm
Power	P	$P=\frac{W}{T}$	L^2MT^{-3}	Erg per second.	Kilogrammeter per second	
Volumic energy	"	$\nu=\frac{W}{V}$	$L^{-1}MT^{-2}$	Erg per cubic centimeter.		
Pressure	p	$p=\frac{F}{S}$	$L^{-1}MT^{-2}$	Dyne per square centimeter.	Kilogramme per square centimeter.	kg/cm²
Moment of a couple	W	$F.L$	L^2MT^{-2}	Dyne-centimeter.	Kilogrammeter.	kgm
Moment of inertia	K	$M.L^2$	L^2M	Gramme-mass-centimeter squared		
Strength of pole	m	$F=\frac{m^2}{L^2}$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-1}$			
Magnetic moment	$\mathfrak{M}$	$\mathfrak{M}=ml$	$L^{\frac{5}{2}}M^{\frac{1}{2}}T^{-1}$			
Intensity of magnetization	$\mathfrak{I}$	$\mathfrak{I}=\frac{\mathfrak{M}}{V}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$			
Specific magnetism	"	$\frac{\mathfrak{M}}{M}$	$L^{\frac{5}{2}}M^{-\frac{1}{2}}T^{-1}$			
Intensity of field	H	$H=\frac{F}{m}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$			
Magnetic flux	Φ	$\Phi=H.S$	$L^{\frac{5}{2}}M^{\frac{1}{2}}T^{-1}$			
Magnetic induction (density of flux)	$\mathfrak{B}$	$\mathfrak{B}=\mu\mathfrak{H}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$			
Permeability	μ	$\mu=\frac{\mathfrak{B}}{\mathfrak{H}}$	A number.		Kilogrammeter.	kgm
Susceptibility	κ	$\kappa=\frac{\mathfrak{I}}{\mathfrak{H}}$	A number.		Kilogrammeter.	kgm
Reluctivity	ρ	$\rho=\frac{1}{\mu}$	A number.			
Reluctance	$\mathfrak{R}$	$\mathfrak{R}=\rho\frac{L}{S}$	L^{-1}			
Permeance	$\mathfrak{P}$	$\mathfrak{P}=\frac{1}{\mathfrak{R}}$	L			
Resistance	R, r	$R=\frac{E}{I}$	LT^{-1}		Ohm.	o
Conductance	"	$\frac{1}{\mathfrak{R}}$	$L^{-1}T$		Mho.	mho
Electromotive force	E	$E=RI$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-2}$		Volt.	v
Intensity of current (current strength)	I	$I=\frac{E}{R}$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$		Ampere.	A
Quantity of electricity	Q	$Q=IT$	$L^{\frac{1}{2}}M^{\frac{1}{2}}$		Coulomb; Ampere-hour.	c; A.h
Capacity	C	$C=\frac{Q}{E}$	$L^{-1}T^2$		Farad.	F
Linear capacity	"	$\frac{C}{L}$	$L^{-2}T^2$		Microfarad per kilometer.	
Electric energy	W	$W=EIT$	L^2MT^{-2}		Joule; Watt-hour.	J.; w.h
Electric power	P	$P=EI$	L^2MT^{-3}		Watt; kilowatt.	W. kw
Resistivity	α	$\alpha=\frac{RS}{L}$	L^3T^{-1}		Ohm-centimeter.	o cm
Conductivity	γ	$\gamma=\frac{1}{\alpha}$	$L^{-2}T$			
Linear insulation	"	$\alpha=RL$	L^2T^{-1}		Megohm-kilometer.	
Co-efficient of self-induction	L_s	$L_s=\frac{\Phi}{I}$	L		Henry	h
Co-efficient of mutual induction	L_m	"	L		Henry.	h
Magnetizing force	$\mathfrak{H}$	$\mathfrak{H}=\frac{4\pi NI}{L}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$			
Magnetomotive force	$\mathfrak{F}$	$\mathfrak{F}=4\pi NI$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$		Ampere turn	a t

The C. G. S. magnetic and electro-magnetic units have not received special names. They are designated by writing "C. G. S. units" after the formula.

1. *L'Industrie Electrique.*
2. See the Western Electrician, May 20, 1893.

But in spite of the rationality of such a change we would not dare to propose it, for it would modify too greatly expressions universally adopted.

To avoid all confusion, we propose to call the ratios of the capacity of a line to its length, which is measured practically in microfarads per kilometer, linear capacity; we propose to call the product of the insulation resistance of a line by its length, linear insulation; and to call the ratio of the resistance of a line to its length the linear resistance. The expressions formerly used, viz., kilometric capacity, kilometric insulation, and kilometric resistance, present the disadvantage of introducing a unit into the definition of a physical quantity, thus preventing coherence in the definition, and necessitating a change in it when the units are changed. We can not too often repeat

that definitions of physical quantities are and should be independent of units.

We propose to reserve the name of co-efficient of self-induction for a magnitude equivalent to a length and defined as the ratio of a flux of force to the strength of current that produces it. There should be created special names to designate the secondary phenomena resulting from the variation of magnetic permeability, the quantities entering into which are equivalent to a coefficient of self-induction. The discussion instigated in the International Society of Electricians by Blondel and Boucherot will certainly lead to an understanding on this point.

The agreement to substitute the name Henry for the word quadrant to designate the practical unit of the co-efficient of self-induction will be unanimous.

In view of the difficulty of creating a coherent system of practical magnetic units it seems useless to employ other units than the C. G. S. units and to give them special names. There is no reason for using the words, gilbert weber, gauss and oersted proposed by the American Institute of Electrical Engineers to designate respectively magnetomotive force, magnetic flux, magnetic induction and magnetic resistance.

Alternating Currents.—We group here all the decisions made or to be made in respect to establishing an international terminology for alternating currents.

The periodic time or period is the interval which separates two passages in the same direction past the zero point or the interval between two alternations. Frequency is the converse of periodic time; it is measured in periods per second. It will be convenient to create a special word to designate the factor $\omega = \frac{2\pi}{T}$ which is equal to 2π times the frequency. J. A. Fleming calls it pulsation. The congress could sanction this designation without going amiss.

The effective current is the square root of the mean square of the current.

The effective difference of potential is the square root of the mean square of the potential difference.

When a circuit is the seat of a periodic electromotive force, and the elements are a resistance R, self-induction L, and a capacity C, the effective current which traverses the circuit is equal to the ratio of the effective electromotive force to a factor called impedance. By designating by ω, 2π times the frequency or pulsation we have the general relation.[1]

$$I\ eff = \frac{E\ eff}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$$

The impedance constitutes the entire radical of this expression. We propose to give the name reactance to the factor within the parenthesis, defining it with Boucherot as a quantity equivalent to a resistance which does not absorb energy and the square of which added to the square of the resistance gives the square of the impedance.

The reactance due to self induction is the product of the pulsation and the co-efficient of self-induction.

The reactance due to capacity is the converse of the product of the pulsation and capacity.

When there is at the same time self-induction and capacity the reactance of the whole is the difference of the two reactances.[2]

The name reactance has the advantage over the designation inductance of being more generally applicable to the actions of induction and capacity.

We do not see the necessity of adopting the expression impressed electromotive force proposed by the American Institute of Electrical Engineers and defined as the ratio of the total activity in an electrically conducting circuit to its instantaneous current strength. With M. Meylan we fail to realize the usefulness of this new term.

Polyphase Currents.—The definitions proposed by the American Institute of Electrical Engineers lack exactness and should be modified. It is proposed to call simple alternating currents those in which there is practically only a single phase. The meaning of this definition wholly escapes us, for an alternating current in one period passes by all the phases of which it is susceptible. On the other hand a simple alternating current generator feeding many derived circuits of which the reactances are different will produce many currents whose phases will not be in harmony.

The discordances of phase of diphase or triphase alternating currents are to be expressed not in degrees but in fractions of a period.

The expression polyphase should be applied not merely when there are more than three currents, but also to diphase and triphase currents.

There is room to complete these propositions by adding observations relating to photometry, but the question does not seem far enough advanced to warrant us in formulating these matters.

All the Denver, Colo., cable street railroads will ultimately be transformed to electric lines. The Broadway and the Colfax avenue lines of the Tramway company will soon be altered, and the Denver Cable company expects to have its new plant in operation in a few days.

Work was begun last week by the Union Railroad company on the new shore electric road, which is to connect East Providence, R. I., with Bullock's Point and intermediate stations. The introduction of the trolley system on the east shore of Narragansett bay is not only hailed with delight by the residents along the line, but by the entire population of Providence. The road, when completed, will open a new pleasure resort, Crescent Park, which will undoubtedly be a source of much profit to the company and considerable gratification to Providence pleasure seekers.

1. The French [illegible] the latter designating [illegible]

2. The [illegible] of [illegible] Henry [illegible]

Light and Other High Frequency Phenomena.[1]

By Nikola Tesla.

PART I.

When we look at the world around us, on nature, we are impressed with its beauty and grandeur. Each thing we perceive, though it may be vanishingly small is in itself a world, that is, like the whole of the visible universe, matter and force governed by law—a world, the contemplation of which fills us with feelings of wonder and irresistibly urges us to ceaseless thought and inquiry. But in all this vast world, of all objects our senses reveal to us, the most marvelous, the most appealing to our imagination, appears no doubt a highly developed organism, a thinking being. If there is anything fitted to make us admire nature's handiwork, it is certainly this inconceivable structure, which performs its innumerable motions in obedience to external influence. To understand its workings, to get a deeper insight into this nature's masterpiece, has ever been for thinkers a fascinating aim, and after many centuries of arduous research men have arrived at a fair understanding of the functions of its organs and senses. Again, in all the perfect harmony of its parts, of the parts which constitute the material or tangible of our being, of all its organs and senses, the eye is the most wonderful. It is the most precious, the most indispensable of our receptive or directive organs; it is the great gateway through which all knowledge enters the mind. Of all our organs it is the one which is in the most intimate relation with that which we call intellect. So intimate is this relation that it is often said that the very soul shows itself in the eye.

It can be taken as a fact, which the theory of the action of the eye implies, that for each external impression, that is for each image produced upon the retina, the ends of the visual nerves concerned in the conveyance of the impression to the mind must be under a peculiar stress or in a vibratory state. It now does not seem improbable that, when by the power of thought an image is evoked, a distinct reflex action, no matter how weak, is exerted upon certain ends of the visual nerves, and therefore upon the retina. Will it ever be within human power to analyze the condition of the retina when disturbed by thought or reflex action by the help of some optical or other means of such sensitiveness that a clear idea of its state might be gained at any time? If this were possible, then the problem of reading one's thoughts with precision, like the characters of an open book, might be much easier to solve than many problems belonging to the domain of positive physical science, in the solution of which many, if not the majority, of scientific men implicitly believe. Helmholtz has shown that the fundi of the eyes are themselves luminous, and he was able to see, in total darkness, the movement of his arm by the light of his own eyes. This is one of the most remarkable experiments recorded in the history of science, and probably only a few men could satisfactorily repeat it, for it is very likely that the luminosity of the eyes is associated with uncommon activity of the brain and great imaginative power. It is fluorescence of brain action, as it were.

Another fact having a bearing on this subject which has probably been noted by many, since it is stated in popular expressions, but which I cannot recollect to have found chronicled as a positive result of observation, is that at times, when a sudden idea or image presents itself to the intellect, there is a distinct and sometimes painful sensation of luminosity produced in the eye, observable even in broad daylight.

The saying, then, that the soul shows itself in the eye, is deeply founded, and we feel that it expresses a great truth. It has a profound meaning even for one who, like a poet or artist, only following his inborn instinct or love for nature, finds delight in aimless thoughts and in the mere contemplation of natural phenomena, but a still more profound meaning for one who, in the spirit of positive scientific investigation, seeks to ascertain the causes of the effects. It is principally the natural philosopher, the physicist, for whom the eye is the subject of the most intense admiration.

Two facts about the eye must forcibly impress the mind of the physicist, notwithstanding he may think or say that it is an imperfect optical instrument, forgetting that the very conception of that which is perfect, or seems so to him, has been gained through this same instrument. Firstly, the eye is, as far as our positive knowledge goes, the only organ which is directly affected by that subtile medium which, science teaches us, must fill all space; secondly, it is the most sensitive of our organs, incomparably more sensitive to the external impressions than any other.

The organ of hearing implies the impact of ponderable bodies, the organ of smell the transference of detached material particles, and the organs of taste and of touch or force the direct contact or at least some interference of ponderable matter, and this is true even in those instances of animal organisms, in which some of these organs are developed to a degree of truly marvelous perfection. This being so, it seems wonderful that the organ of sight solely should be capable of being stirred by that which all our other organs are powerless to detect, which yet plays an essential part in all natural phenomena, which transmits all energy and sustains all motion and, that most intricate of all, life, but which has properties such that even a scientifically trained mind cannot help drawing a distinction between it and all that is called matter. Considering merely this, and the fact that the eye, by its marvelous power, widens our otherwise very narrow range of perception far beyond the limits of the small world which is our own, to embrace myriads of other worlds, suns and stars in the infinite depths of the universe, would make it justifiable to assert that it is an organ of a higher order. Its performances are beyond comprehension. Nature as far as we know never produced anything more wonderful. We can get barely a faint idea of its prodigious power by analyzing what it does and by comparing. When ether waves impinge upon the human body, they produce the sensations of warmth or cold, pleasure or pain, or perhaps other sensations of which we are not aware, and any degree or intensity of these sensations, which degrees are infinite in number, hence an infinite number of distinct sensations. But our sense of touch or our sense of force cannot reveal to us these differences in degree or intensity, unless they are very great. Now we can readily conceive how an organism, such as the human in the eternal process of evolution, or, more philosophically speaking, adaptation to nature, being constrained to the use of only the sense of touch or force, for instance, might develop this sense to such a degree of sensitiveness or perfection that it would be capable of distinguishing the minutest differences in the temperature of a body even at some distance, to a hundredth or thousandth or millionth part of a degree. Yet even this apparently impossible performance would not begin to compare with that of the eye, which is capable of distinguishing and conveying to the mind in a single instant innumerable peculiarities of the body, be it in form or color or other respects. This power of the eye rests upon two things, namely, the rectilinear propagation of the disturbance by which it is affected, and upon its sensitiveness. To say that the eye is sensitive is not saying anything. Compared with it, all other organs are monstrously crude. The organ of smell which guides a dog on the trail of a deer, the organ of touch or force which guides an insect in its wanderings, the organ of hearing, which is affected by the slightest disturbances of the air, are sensitive organs, to be sure, but what are they compared with the human eye! No doubt it responds to the faintest echoes or reverberations of the medium; no doubt, it brings us tidings from other worlds, infinitely remote, but in a language we cannot as yet always understand. And why not? Because we live in a medium filled with air and other gases, vapors and a dense mass of solid particles flying about. These play an important part in many phenomena; they fritter away the energy of the vibrations before they can reach the eye; they too are the carriers of germs of destruction; they get into our lungs and other organs, clog up the channels and imperceptibly yet inevitably arrest the stream of life. Could we but do away with all ponderable matter in the line of sight of the telescope, it would reveal to us undreamt-of marvels. Even the unaided eye, I think, would be capable of distinguishing in the pure medium small objects at distances measured probably by hundreds or perhaps thousands of miles.

But there is something else about the eye which impresses us still more than these wonderful features which we observe, viewing it from the standpoint of a physicist, merely as an optical instrument—something which appeals to us more than its marvelous faculty of being directly affected by the vibrations of the medium, without interference of gross matter, and more than its inconceivable sensitiveness and discerning power. It is its significance in the processes of life. No matter what one's views on nature and life may be, he must stand amazed when, for the first time in his thoughts, he realizes the importance of the eye in the physical processes and mental performances of the human organism. And how could it be otherwise, when he realizes, that the eye is the means through which the human race has acquired the entire knowledge it possesses, that it controls all our motions, more still, all our actions.

There is no way of acquiring knowledge except through the eye. What is the foundation of all philosophical systems of ancient and modern times, in fact of all the philosophy of man? *I am, I think; I think, therefore I am.* But how could I think and how would I know that I exist, if I had not the eye? For knowledge involves consciousness; consciousness involves ideas, conceptions; conceptions involve pictures or images, and images, the sense of vision, and therefore the organ of sight. But how about blind men, will be asked? Yes, a blind man may depict in magnificent poems forms and scenes from real life, from a world he physically does not see. A blind man may touch the keys of an instrument with unerring precision, may build the fastest boat, may discover and invent, calculate and construct, may do still greater wonders —but all the blind men who have done such things have descended from those who had seeing eyes. Nature may reach the same result in many ways. Like a wave in the physical world, in the infinite ocean of the medium which pervades all, so in the world of organisms, in life, an impulse started proceeds onward, at times, may be, with the speed of light, at times, again, so slowly that for ages and ages it seems to stay, passing through processes of a complexity inconceivable to men, but in all its forms, in all its stages, its energy ever and ever integrally present. A single ray of light from a distant star falling upon the eye of a tyrant in bygone times may have altered the course of his life, may have changed the destiny of nations, may have transformed the surface of the globe, so intricate, so inconceivably complex are the processes in Nature. In no way can we get such an overwhelming idea of the grandeur of Nature, than when we consider, that in accordance with the law of the conservation of energy, throughout the Infinite, the forces are in a perfect balance, and hence the energy of a single thought may determine the motion of a universe. It is not necessary that every individual, not even that every generation or many generations, should have the physical instrument of sight, in order to be able to form images and to think, that is, form ideas or conceptions; but sometime or other during the process of evolution, the eye certainly must have existed, else thought, as we understand it, would be impossible; else conceptions, like spirit, intellect, mind, call it as you may, could not exist. It is conceivable that in some other world, in some

1. A lecture delivered before the Franklin Institute at Philadelphia February 24, 1893, and before the National Electric Light association at St. Louis, Mo., March 1, 1893.

other beings, the eye is replaced by a different organ, equally or more perfect, but these beings cannot be men.

Now what prompts us to all voluntary motions and actions of any kind? Again the eye. If I am conscious of the motion, I must have an idea or conception, that is, an image, therefore the eye. If I am not precisely conscious of the motion, it is because the images are vague or indistinct, being blurred by the superimposition of many. But when I perform the motion, does the impulse which prompts me to the action come from within or from without? The greatest physicists have not disdained to endeavor to answer this and similar questions and have at times abandoned themselves to the delights of pure and unrestrained thought. Such questions are generally considered not to belong to the realm of positive physical science, but will before long be annexed to its domain. Helmholtz has probably thought more on life than any modern scientist. Lord Kelvin expressed his belief that life's process is electrical and that there is a force inherent to the organism and determining its motions. Just as much as I am convinced of any physical truth I am convinced that the motive impulse must come from the outside. For, consider the lowest organism we know—and there are probably many lower ones—an aggregation of a few cells only. If it is capable of voluntary motion it can perform an infinite number of motions, all definite and precise. But now a mechanism consisting of a finite number of parts, and few at that, cannot perform an infinite number of definite motions, hence the impulses which govern its movements must come from the environment. So, the atom, the ulterior element of the universe's structure, is tossed about in space eternally, a play to external influences, like a float in a troubled sea. Were it to stop its motion it would die. Matter at rest, if such a thing could exist, would be matter dead. Death of matter! Never has a sentence of deeper philosophical meaning been uttered. This is the way in which Prof. Dewar forcibly expresses it in the description of his admirable experiments, in which liquid oxygen is handled as one handles water, and air at ordinary pressure is made to condense and even to solidify by the intense cold—experiments, which serve to illustrate, in his language, the last feeble manifestations of life, the last quiverings of matter about to die. But human eyes shall not witness such death. There is no death of matter, for throughout the infinite universe all has to move, to vibrate, that is, to live.

I have made the preceding statements at the peril of treading upon metaphysical ground in my desire to introduce the subject of this lecture in a manner not altogether uninteresting, I may hope, to an audience such as I have the honor to address. But now then, returning to the subject, this divine organ of sight, this indispensable instrument for thought and all intellectual enjoyment, which lays open to us the marvels of this universe, through which we have acquired what knowledge we possess, and which prompts us to, and controls, all our physical and mental activity—by what is it affected? By light! What is light?

We have witnessed the great strides which have been made in all departments of science in recent years. So great have been the advances that we cannot refrain from asking ourselves: Is this all true, or is it but a dream? Centuries ago men have lived, have thought, discovered, invented, and have believed that they were soaring, while they were merely proceeding at a snail's pace. So we too may be mistaken. But taking the truth of the observed events as one of the implied facts of science, we must rejoice in the immense progress already made and still more in the anticipation of what must come, judging from the possibilities opened up by modern research. There is, however, an advance which we have been witnessing, which must be particularly gratifying to every lover of progress. It is not a discovery, or an invention, or an achievement in any particular direction. It is an advance in all directions of scientific thought and experiment. I mean the generalization of the natural forces of phenomena, the looming up of a certain broad idea on the scientific horizon. It is this idea which has, however, long ago taken possession of the most advanced minds, to which I desire to call your attention and which I intend to illustrate, in a general way, in these experiments, as the first step in answering the question "What is light?" and to realize the modern meaning of this word.

It is beyond the scope of my lecture to dwell upon the subject of light in general, my object being merely to bring presently to your notice a certain class of light effects and a number of phenomena observed in pursuing the study of these effects. But to be consistent in my remarks it is necessary to state that according to that idea, now accepted by the majority of scientific men as a positive result of theoretical and experimental investigation, the various forms or manifestations of energy which were generally designated as "electric" or more precisely "electro-magnetic" are energy manifestations of the same nature as those of radiant heat and light. Therefore the phenomena of light and heat and others besides these may be called electrical phenomena. Thus electrical science has become the mother science of all and its study has become all important. The day when we shall know exactly what "electricity" is will chronicle an event probably greater, more important than any other recorded in the history of the human race. The time will come when the comfort, the very existence perhaps, of man will depend upon that wonderful agent. For our existence and comfort we require heat, light and mechanical power. How do we now get all these? We get them from fuel, we get them by consuming material. What will man do when the forests disappear, when the coal fields are exhausted? Only one thing, according to our present knowledge will remain; that is, to transmit power at great distances. Men will go to waterfalls, to the tides, which are the stores of an infinitesimal part of nature's immeasurable energy. There will they harness the energy and transmit the same to their settlements, to warm their homes by, to give them light, and to keep their obedient slaves, the machines, toiling. But how will they transmit this energy if not by electricity? Judge then, if the comfort, nay, the very existence, of man will not depend on electricity. I am aware that this view is not that of a practical engineer, but neither is it that of an illusionist, for it is certain that power transmission, which at present is merely a stimulus to enterprise, will some day be a dire necessity.

It is more important for the student, who takes up the study of light phenomena to make himself thoroughly acquainted with certain modern views, than to peruse entire books on the subject of light itself, as disconnected from these views. Were I therefore to make these demonstrations before students seeking information—and for the sake of the few of those who may be present, give me leave to so assume—it would be my principal endeavor to impress these views upon their minds in this series of experiments.

It might be sufficient for this purpose to perform a simple and well-known experiment. I might take a familiar appliance, a Leyden jar, charge it from a frictional machine, and then discharge it. In explaining to you its permanent state when charged and its transitory condition when discharging, calling your attention to the forces which enter into play and to the various phenomena they produce, and pointing out the relation of the forces and phenomena, I might fully succeed in illustrating that modern idea. No doubt, to the thinker, this simple experiment would appeal as much as the most magnificent display. But this is to be an experimental demonstration, and one which should possess instructive as well as entertaining features, and as such a simple experiment, like the one cited, would not go very far toward the attainment of the lecturer's aim. I must therefore choose another way of illustrating, more spectacular certainly, but perhaps also more instructive. Instead of the frictional machine and Leyden jar, I shall avail myself in these experiments of an induction coil of peculiar properties, which was described in detail by me in a lecture before the London Institution of Electrical Engineers, in February, 1892. This induction coil is capable of yielding currents of enormous potential differences, alternating with extreme rapidity. With this apparatus I shall endeavor to show you three distinct classes of effects, or phenomena, and it is my desire that each experiment, while serving for the purposes of illustration, should at the same time teach us some novel truth, or show us some novel aspect of this fascinating science. But before doing this, it seems proper and useful to dwell upon the apparatus employed, and method of obtaining the high potentials and high frequency currents which are made use of in these experiments.

General Electric Company's New Street Railway Motor.

The new motor known as "G. E. 800" which the General Electric company has just placed on the market, and which is illustrated in the accompanying cuts, is a four-pole motor, the principal characteristic of which is that it is a lighter street railway motor for a given output than has been heretofore employed. The matter of reduction of weight has been studied with considerable care, and this motor is even lighter than the 15 horse power motor formerly sold by the General Electric company. In suspending the motor on the cross frame of the truck it will be so hung that only 500 pounds of its weight will bear directly on the axle. From this it will readily be seen that the dead blow delivered from the axle to the truck is greatly reduced when comparison is made with the work of other motors.

The working parts are easily accessible, as seen by reference to Fig. 1, which presents a front view. The aperture necessary for the purpose of inspection, cleaning, etc., is so designed that, when closed, those parts which could be damaged by water, the brush holders, commutator, armature and field spools, are so entirely enclosed in a water-tight box that the entire motor could be immersed in water and still operate as under normal conditions. This closing of the motor so as to make it water and dust-proof has been rendered possible by its superior design and the liberal use of copper and the best grade of steel in its construction, whereby the heat generated in the motor has been materially reduced. The motor, even closed up as it is, a representation of which is given in the side view, Fig. 2, runs much cooler than previous motors that were entirely exposed. It can be taken apart with the utmost facility. The top frame is hinged on the lower frame, and with its proper parts weighs only 350 pounds. On the removal of only two bolts it can be thrown back completely out of the way of the armature, or by the removal of the hinge pins the top frame can be lifted into the car, or by moving the nose plate forward the motor can be swung upon the ring axle as a hinge, so as to be accessible from the pit, the top field then being swung on its hinges still lower into the pit, in which position the armature and field spools can be easily removed; or by the removal of the top of the gear case and two axle caps the motor can be lowered as a whole into the pit. The armature is short and can be lifted through an ordinary trap door. It will thus be seen that the motor can be handled either inside the car or from without with almost equal facility. On opening the lid over the commutator easy access is had to the whole width of the commutator and brush holders, the latter being of the simplest possible construction, and easily operated. There is also plenty of space to permit of the pit of the motor being reached. The construction is such that it is practically impossible for any grease to get inside of the motor.

The armature is similar to that used on the W. P. motors, and is made both in the Gramme ring armature and in the drum form. The drum winding has been carefully studied, and the many objections to the various kinds of drum windings that have from time to time been put upon the market have been carefully guarded against. A thorough trial has demonstrated that the drum winding of this motor can be relied upon. It will be free from the danger of burning out at the ends, heretofore common with this kind of winding. The Gramme armature and drum armature are interchangeable.

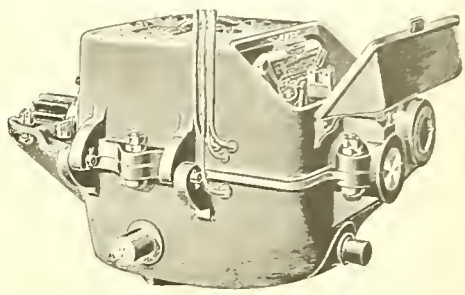

FIG 2. GENERAL ELECTRIC COMPANY'S NEW STREET RAILWAY MOTOR.

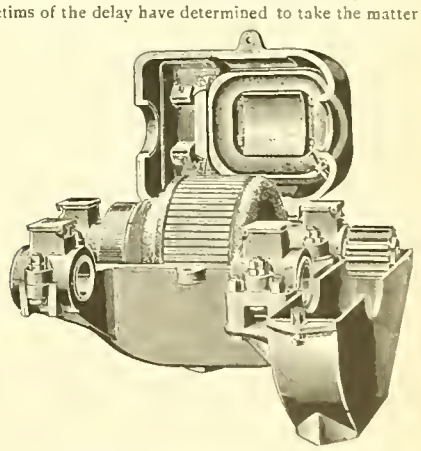

FIG. 1. GENERAL ELECTRIC COMPANY'S NEW STREET RAILWAY MOTOR.

CORRESPONDENCE.

New York Notes.

NEW YORK, MAY 27.—It is a healthy sign that the citizens of New York are beginning to indicate an intention to formulate a practical protest against the farce that has been carried on under the pretence of providing rapid transit for the city. The people of the upper portion of the city have become thoroughly aroused on the subject, and have resolved to hold a mass meeting on Monday night at Madison Hall to give expression to their sentiments regarding the course thus far taken by the Rapid Transit commission. The meeting is expected to take the form of an immense popular demonstration, and will be addressed by some of the leading citizens. The failure of the negotiations between the Rapid Transit commission and the Manhattan Railway company leaves the matter of rapid transit in the same position that it occupied when the commission was first appointed, and the long suffering victims of the delay have determined to take the matter in their own hands, and by an overwhelming popular expression give the public an opportunity to know just where they stand at the present juncture. It is understood that resolutions will be passed at the meeting asking for the resignation of certain members of the commission. This demonstration will be strongly supported by the most influential section of the city press. The *Sun* has not hesitated to charge J. H. Starin and E. L. Bushe, members of the commission, with being actuated by improper or misunderstood motives in standing out against the requests of the Manhattan company, and a monster petition is being circulated up town, and generally signed, asking the mayor to remove the two commissioners on the grounds "of incompetence and neglect of duty, and for failure to perform the duties of their office." and to appoint in their place "men competent and

willing to faithfully, and with reasonable expedition and economy, perform the duties of the Rapid Transit commission for this city, who will act in the interest of the people only." Various new schemes may be expected to be placed before the commission. One of these has already been outlined, and is said to be backed by Thomas Breen. Mr. Breen proposes a viaduct, and is ready to prove his good faith by showing his ability to control $10,000,000, and to deposit with the city as a guaranty of the performance of any contract he may undertake $1,000,000 in cash. He proposes to build a six-track railway, two tracks for local business, two for express business, and two for freight, and to erect elevators at each station to carry passengers from the street. The road is to cost $95,000,000, and to extend from the Battery to Peekskill. Although the road would carry heavy engines, they would condense their steam and burn their own smoke, and the assurance is given that occupants of adjoining property would not be annoyed by the noise or concussion of the trains.

The arbitration on the question of extra fare on the special World's Fair train to Chicago was closed yesterday. A decision was rendered requiring the New York Central to charge but $6 extra on this train, which is $4 less than was originally proposed. Persons who desire to go to Chicago on this twenty hour train, therefore, will be obliged to pay $31 each way. That figure includes the regular first-class fare of $20, the Wagner sleeping-berth fare of $5 and the extra fare of $6. At 3 o'clock tomorrow afternoon the "Expositson flier" will start on its first regular trip, and is scheduled to reach Chicago about 10 o'clock on Monday forenoon.

An epidemic of strikes among electrical workmen seems to have set in. The workmen in the Thomson-Houston Electric Works have demanded fifty-eight hours' pay for a week of fifty-four hours. The manager of the works posted a proposition to the men that they should work nine hours a day, including Saturday, or ten hours five days a week and a half-holiday Saturday, and he refused to pay the same wages for shorter time. A mass meeting of the men held on Thursday night was unanimously in favor of insisting on their first demands. It is said that unless these demands are conceded, a general strike involving 4,000 men will be ordered.

When the strike of the employes of H. Ward Leonard & Co. occurred two weeks ago, the Electrical Contractors' association, which employs nearly five hundred men, informed the union that if the strike were not declared off the members of the association would discharge all the union men. As the strike continued, the association advertised in several of the morning papers for non-union men. The situation, as defined by Mr. Leonard, is said to be as follows: The association has made up its mind to employ non-union men. After the strike a year ago, a contract was entered into between the firms and the union, the terms of which could not be terminated without six months' notice in writing. In this contract the association was permitted to retain the non-union men employed during the strike. It was also agreed that all disputes between men, bosses and contractors should be settled by arbitration. Now the union leaders decline to arbitrate, and repudiate their contract. In order to test the action of the association they decided to strike, and about two weeks ago ordered the men out. The major part of the linemen, however, finding they had no support among other trades, declined to go out. The leaders of the union now wait the association to discharge the non-union men who were employed during the strike a year ago, and also to discharge men who are in arrears to the union. The whole trouble seems to arise not from a difficulty of wages or hours, but simply that the union has found that the contract is not all that was expected of it, and it wants to terminate it and have a new one without waiting the full six months. In advertising for non-union workmen, the association indicates its intention of running its business in spite of intimidation in the future.

An incident occurred recently that shows the omnipresence and industry of the representatives of the daily press. A meeting of the Laryngological section of the Academy of Medicine was held on Thursday evening. At the meetings of the respective sections of the Academy it is the custom for some member to read a paper or make a few remarks on a subject likely to be of special or timely interest, and on this occasion Dr. Wendell Phillips, a leading authority on the treatment of the throat, nose and ear, showed the assembly what could be done in the way of throwing the rays of an electric light into different parts of the head, so that morbid processes could be detected. The speaker thought his audience was restricted to his professional brethren, innocent that among them was "a chiel takin' notes." A reporter had strayed in, and the next morning the *Sun* had a paragraph telling of the wondrous way in which the cheeks and eyes of a boy who had been experimented upon. It was only a few lines, but it was quite enough to bring an inundation of reporters to the consulting room of the unfortunate doctor, who little knew the hornets' nest he had got into. He told them the simple story of transillumination by means of the electric lamp, as it has been long practiced by the medical profession, but the various versions of the process that were detailed in the evening papers did more credit to the ingenuity of the reporters than to their scientific accuracy. The doctor has had a rough time at his clinic, of which he stands at the head, ever since, and his coadjutors twit him, half in joke and half in earnest, with laying a trap for an advertisement. Fortunately, however, his reputation places him above any such suspicion. He is known to be a conscientious worker, alive to the importance of the most approved scientific methods in electro-therapeutics, and that a wide-awake press has been the means of bringing that fact into prominence outside the circle for which his remarks and illustrations were intended can only be regarded with satisfaction. W. F. O.

Northwestern Notations.

MINNEAPOLIS, May 27.—Supt. C. P. Waisman of the Northwestern Telephone company will visit Grand Forks, N. D., with the view of investigating the feasibility of constructing a line that shall afford Reynolds and other towns on the Great Northern line telephone connection with that city. Supt. Waisman estimates the cost of construction at $100 per mile.

The formal opening of the electric street car line at Brainerd, Minn., occurred recently. Citizens tendered C. N. Parker, the owner, an ovation, and were in turn given a trip over the three and a half miles of road with a band in attendance. The line runs from the south end of Sixth street to Rice Lake, where the Northern Mills company's works are located, and which is also the terminus of the Brainerd & Northern Minnesota railroad. The proprietor has expended $50,000 in the construction of the line.

More discharges in the Western Union Telegraph offices in Minneapolis and St. Paul has caused commotion. Fifteen operators have been dismissed during the past two months. Various reasons are given and rumored. In some cases the report that it was due to union matters is denied by the company's officials, who say that the men's work is not satisfactory.

A movement to put in a telephone system at Little Falls, Minn., is again being made. Thomas Bailey is taking an active part in the work. He expects to obtain 50 subscribers at $3.50 a month each.

It has been suggested that it would be an excellent idea to put ten or a dozen arc lights on the top of the big chimney being erected at the new electric light power house at Duluth. It is claimed that that number of lights on the smokestack would light not only the harbor and railroad yards in that vicinity, but the canal as well, and would serve as an excellent beacon light for vessels at night.

The Brush Electric company of Minneapolis is increasing its plant at Third avenue north and the river, and has awarded the Cooley & Vater company of this city the contract for installing a 1,200 horse power compound condensing Corliss engine, which will be the largest engine, it is believed, in the Northwest.

The citizens of Minneapolis are to be provided with ample and increased street car facilities this summer. The company has had built 85 open cars and 30 new cars for the interurban line. The new cars will be somewhat larger than the ones now in use and constructed after the most approved modern pattern, being attractive in appearance and having all the modern conveniences.

Anoka, Minn., is having trouble with the company that supplies the place with light and water, and it is expected that a bill of $3,000 for such services will be contested in the courts. The company is controlled by Mr. Sykes of Minneapolis.

A large number of people gathered at the store adjoining the electric light office at Great Falls, Mont., in response to an invitation from Superintendent Dickenson to witness a practical trial of electric cooking and heating apparatus. Among the different utensils to be seen in operation were a bake oven, broiler, chafing dish, stew pan, tea kettle, coffee pot, tea pot, pancake griddle, heating disc, water heater, flat-iron, curling iron, sewing machine motor, fan motor, glue pot and a room heater. The experiments were all successful and aroused great interest.

Another stage has been reached in the legal fight between the Winnepeg Street Railway company and the electric railway company which has recently commenced operations. The former, which has been established for the last ten years, claims to have been given exclusive rights to the streets by the city council. The first case came before the Court of Queen's Bench, which decision was favorable to the new electric company. An appeal was taken to the full Supreme Court of Manitoba, the judges of which unanimously ruled that the city council had no power to grant a monopoly of the streets, and holding that the new company could not be interfered with. The solicitors of the defendant corporation at once filed notice that they would take an appeal to the privy council of England. The new company includes among its directors President Van Horne of the Canadian Pacific road.

Both branches of the St. Paul local legislature have finally passed a street railway ordinance, which seems to be a solution of the situation. The mayor has signed it, and all that remains is the approval of the street car people. It is believed that they will accept it. The only change from the last ordinance is a requirement that the East Seventh street cable be changed to an electric line and be joined with the West Seventh street line by September 1, 1895, and the further requirement that the Maria avenue line shall be operated to Robert street by that date. As President Lowry has indicated a desire to do this, it is presumed that the amendments will be satisfactory.

Work has been begun on the electric light building at Spring Valley, Minn.

A Minneapolis alderman has a proposition which he threatens to bring before the council. He proposes to tax street cars at the rate of $25 per car annually. There are 619 cars now in operation, and this proposition, if it goes through, will cost the company annually $15,475.

The Red Wing Gas & Electric Light company has elected the following named officers: President, T. B. Sheldon; vice-president, John Hack; secretary and treasurer, W. H. Putnam; general manager, J. C. Pierce; superintendent, John Nelson.

The new electric plant at Cumberland, Wis., works well, and there is talk of extending the wires over the entire city.

The Livingston, Mont., Electric Light company is arranging to consolidate its water and steam power plants. An addition to the power house west of the city will be erected at once.

Motorman Charles Engdahl of West Superior, Wis., has been arrested charged with criminal negligence amounting to manslaughter. The warrant was sworn out by the relative of a child that was run over and killed. Engdahl is held at $1,000 bail.

The Waseca, Minn., city council has ordered a special election for voting on a proposition to bond the city for an electric light plant. The sentiment of the city is almost unanimously in favor of the project, it is stated.

At Chippewa Falls, Wis., the jury in the case of A. Johnson against the Wisconsin Telephone company brought in a verdict in favor of the plaintiff and awarded damages to the amount of $9,258.73. The suit was to recover damages for a barn that was burned. A bolt of lightning followed one of the wires, which was strung over the roof of the barn. The case was tried twice before, but the jury disagreed.

The council at Valley City, N. D., has passed an ordinance granting a twelve-year electric light franchise to Amundson & Sandbeck. The plant is to be put into operation within six months, and if not the franchise will be revoked.

At La Crosse, Wis., material has been received and preparations have been made for transforming the street car system from horse power to electricity. The Thomson-Houston system has been adopted and the power plant will have two dynamos of 135 horse power each, and they will be of the multipolar type. The cars have been made by the St. Louis Car company, and are ready for shipment. N. L. P.

PERSONAL.

President Elias E. Ries, of the Ries Electric Specialty company of Baltimore, was a visitor at the New York office of the WESTERN ELECTRICIAN last week.

M. M. Hayden, of the Laws Battery company of New York, left last week on an extended tour through the West, in the interest of his company. He will not return until fall.

Ralph L. Shainwald, president of the Standard Paint company, New York, is now in Chicago. Mr. Shainwald is visiting the World's Fair and combining business with pleasure.

Secretary H. M. Nichols, of the Redding Electric company of Boston, Mass., was in New York last week on a trip through that state, where he closed several large orders for the many specialties which this company manufactures.

J. B. Wethrell, who has been an assistant to Lieut Badt, in the mining department of the western office of the

General Electric company, has accepted a position with the Chicago Edison company and is now associated with L. A. Ferguson in isolated lighting work.

The electrical fraternity will be interested to know that C. A. Daigh has accepted a position as general sales agent for the Siemens & Halske Electric company. Mr. Daigh's headquarters will be at the Chicago office of the company in the Monadnock building. The Siemens & Halske company is to be congratulated upon obtaining so energetic and pushing a man as Mr. Daigh.

J. A. Seely, C. O. Baker and C. A. Bragg of New York are planning a dinner of the planked shad style as a compliment to James I. Ayer of St. Louis, who is expected East in a few weeks, as a small recognition of the many courtesies extended to eastern men in St. Louis at the recent electric light convention, when he was the president of the association. The dinner will take place at Gloucester, N. J.

NEW INCORPORATIONS.

Boulder Electric Power company, Creighton, Neb., and Independence, Mont.; capital stock, $500,000; to do a general electric power business.

Electrical & Mechanical Manufacturing company, New York, N. Y., capital stock, $15,000; to manufacture and sell electrical and mechanical apparatus.

College Hill Electric Railway company, Cincinnati, O.; capital stock, $10,000; building and operating an electric railway; C. B. Matthews, Cincinnati, O.

Towanda Traction company, Towanda, Pa.; capital stock, $42,000; constructing and operating an electric railway in Bradford county, Pa.; James H. Codding, Towanda, Pa.

Bar Harbor Electric Light company, Portland, Me.; capital stock, $75,000; to manufacture and deal in gas and electricity for heat, light and power; H. and H. B. Cleaver, Portland, Me.

Electrical Supply & Construction company, Kansas City, Kan.; capital stock, $10,000, to buy, sell, handle and manufacture supplies, equipments and appliances for electric light, power, etc.

Hillsboro Water, Light & Power company, Hillsboro, Tex.; capital stock, $50,000; to supply the public with light and power by electricity and also with water; D. M. Crosthwait, Hillsboro, Tex.

Peoria Street Railway company, Peoria, Ill.; capital stock, $100,000; to build, operate and maintain electric street railway in the county of Peoria, Ill.; Arthur Keithley, 205 Y. M. C. A. building, Peoria, Ill.

Electric Light & Power company of Sayre, Pa., Sayre, Pa.; capital stock, $3,000; furnishing light, heat and power by electricity to the public in Sayre, Bradford county, Pa.; H. F. Maynard, Athens, Pa.

Tioga Point Electric Light & Power company, Athens, Pa.; capital stock, $3,000; furnishing light, heat and power by electricity to the public in Athens, Bradford county, Pa.; H. F. Maynard, Athens, Pa.

Allegheny Valley Heat, Light & Power company, New Kensington, Pa.; capital stock, $15,000, manufacturing and supplying light, heat or power to the public at New Kensington, Pa.; John T. Reeves, Beaver Falls, Pa.

Mount Pleasant & Hammondville Electric Street Railway company, Mount Pleasant, Pa.; capital stock, $18,000; constructing and operating an electric railway in Fayette county, Pa.; I. J. McWilliams, Mount Pleasant, Pa.

Calkins Electric Burner company of Illinois, Chicago, Ill.; capital stock, $120,000; to manufacture and deal in heating and cooking apparatus and appliances, to operate oil wells, refine, use and sell oil, etc; Warren & Cox, 115 Dearborn street, Chicago, Ill.

Red Bank Electric Light & Power company, Red Bank, N. J.; capital stock, $50,000; to purchase, construct, maintain and operate works for the supply and distribution of electricity for electric light, heat and power, etc.; George M. Lane, Asbury Park, N. J.

Beverly & Edgewater Park Electric Light & Power company, Beverly, N. J.; capital stock, $30,000; to construct, maintain and operate works for the supply and distribution of electricity for electric light, heat and power George M. Lane, Asbury Park, N. J.

Muncie Electrical Railway company, Muncie, Ind.; capital stock, $200,000; constructing, maintaining and operating by means of electricity or other motive power, lines of street railway in Muncie, Ind., and in neighboring cities and towns, and also to dispose of electricity for lighting, power and other purposes; Muncie Electrical Railway company, Muncie, Ind.

ELECTRIC LIGHTING.

Washington, N. J., is to have an electric light plant.

Port Washington, Wis., is to be lighted by electricity.

The Mountain Electric company will put in a plant to light the city of Trinidad, Colo.

The people of Danvers, Mass., have authorized the common council to put in a municipal lighting plant.

Iroquois, Ont., suffered the loss of its electric light plant a few weeks ago. The loss is estimated from $6,000 to $10,000, covered by insurance.

The city council of Rome, N. Y., has instructed the mayor to appoint a committee of three to investigate as to the advisability of establishing a municipal electric light system.

Edgewater, N. Y., has advertised for bids for lighting the streets for one year from sunset to sunrise, New York City schedule, with incandescent lamps of 25 candle power or gas of the same power.

Representatives of various electric companies having plants in Hyde Park, Chicago, called upon the commissioner of public works and the corporation counsel last week and notified them that they had agreed among themselves to take down all the poles in the district except one line on each street. The agreement was ratified by the corporation counsel.

ELECTRIC RAILWAYS.

An electric railway is projected from Falls Church to Washington, D. C.

An electric road is to be built to connect Trenton and Bardentown, New Jersey.

The Oakland avenue line in Lyons, Iowa., is to be equipped for electrical service.

An electric railway for passenger traffic is to be constructed from Douglas to Laxey in the Isle of Man.

An electric railway is projected from Northeast Baltimore to Lake Montebello, a distance of about five miles.

Rights of way are being secured for an electric railway between Youngstown via Hubbard and Brookfield to Sharon, O.

A company has been organized to build an electric railway 12 miles in length to connect Manor, Pa., with outlying towns.

The Houston City, Tex., Street Railway company is to extend its electric lines to the Volksfest grounds, through Lubbock Grove.

The electric system of the Mobile Street Railway company will be completed and the road opened for traffic about August 1st.

A movement is on foot to build an electric railway running from Lenoir, N. C., to Blowing Rock. It is estimated the proposed enterprise will cost $350,000.

It is stated that an electric railroad from Indianapolis to Marysinsville, Ind., a distance of 30 miles, is projected by a company that has filed articles of incorporation.

The Buffalo & Tonawanda Electric Railway company, Buffalo, N. Y., has obtained the right of way to build and operate an electric railway line from Buffalo to Niagara Falls.

The Wissahickon, Pa., Electric Railway company has made a contract for the electric railway to be shortly put into operation in Manayunk, Wissahickon and Roxborough.

The officers of the Sandlake Plank Road company are negotiating with New York capitalists with a view of constructing an electric railway from Albany, N. Y., to Sandlake.

The Delaware & Schuylkill Electric Railway company has applied to the city council for the right to lay tracks in three wards in Philadelphia and to operate the road by the trolley system.

Chas. D. Jones and A. R. Bliss of the Consolidated Electric company have effected an arrangement with the Canada Electric company for the purchase of its entire electrical manufacturing equipment.

The General Electric company has secured the temporary use of the Crescent Beach loop of the Boston and Maine railroad for the purpose of carrying out a series of experiments relative to the application of electricity to steam roads.

The street railway company of Kingston, Ont., is applying to the Ontario Legislature for an amendment to its charter. The company asks for permission to use electricity, to alter its gauge, and to run its lines on new streets.

The Vicksburg Street Railway company, Vicksburg, Miss., and the Hill City Electric Light company have effected a consolidation, which is understood to be a preliminary step towards the building of an extensive system of electric railway.

The county commissioners of Huron county, O., have granted a franchise to the Sandusky, Huron & Milan Electric Railway company, to run a line over the Old State road, between Milan and Norwalk. The line will soon be constructed.

O. L. Bannard of the Continental Trust company of New York has bought the Nashville Electric Railway & Power company plant for $20,000, by order of court in the case of the Detroit Electrical Works against the Nashville Railway & Power company.

An electric belt road will be in running order around the battlefield at Gettysburg by July 1st. Twelve double-decker cars of 60 horse power each, with a trailer, will be put on, and these will be capable of carrying 2,000 people an hour over the field.

It is rumored that Cleveland and Pittsburg capitalists contemplate building an electric railroad to connect Cleveland and Pittsburg. The names of Daniel Peels, Mark A. Hanna and C. F. Brush of Cleveland are mentioned as those of men interested in the enterprise.

The new electric line known as the Buffalo, North Main street and Tonawanda electric railroad has been opened for public use. The officers and directors of the new company are: President, L. F. W. Arend; vice-president, A. T. Fancher; secretary, Edward Rutherford; treasurer Charles C. Mead.

An electric railway will soon be constructed from Stockholm to Djursholm, Sweden. The electric appliances are to be furnished by a firm in Manchester, England, while the boilers and steam engines will be made at Eskilstuna. The work will be pushed so that the line may be opened for general traffic next fall.

The Portland Consolidated Street Railway company, which about a year ago purchased the Portland and Vancouver railway, is having the entire line changed into an electric system. Other changes will be made entailing an aggregate cost of about $100,000. The motors have been purchased from the Northwest General Electric company and the Westinghouse company.

An electric railway is to be built between and through the cities of Dunkirk, Ind., and Redkey. The company building the road proposes to put in an arc and incandescent light plant in each city and contracts to light them with a forty-two thousand candle power plant. The road will be about five miles long and a power station will be erected mid way between the two places.

The Brooklyn, Bath & West End Railroad company, Brooklyn, N. Y., has filed an application with the state railroad commission to change its motive power from steam to electricity on the present line of its steam railroad, and also on its line from 41st street and New Utrecht avenue, in New Utrecht, to 10th avenue and 39th street, Brooklyn, which it will connect with the tracks of the South Brooklyn & Terminal company.

Electric cars have been started on the cross-town lines of the Chicago City Railway company. After several experimental trips the lines were opened for traffic on May 22d. On Forty-seventh street twelve cars run between Cottage Grove and Western avenues. Electric cars are also now running on Sixty-third street. The electric power house is situated in the rear of the cable power-house on State street south of Fifty-second street.

The directors of the Frankford & Southwark Passenger Railway company of Philadelphia have concluded, it is said, that the best and easiest way to get the necessary funds to install the trolley on the 100 miles of road in its system will be to organize a new company under the traction act of 1887, which will absorb and operate the Frankford & Southwark road and its allied lines. Accordingly, application will be made for a charter for the Electric Traction company of Philadelphia. The capital at first will be small, but provision will be made for its increase as needed. The purpose of the new company will be to furnish the funds necessary to equip with the trolley the Frankford and Southwark system. The new company will probably eventually lease the Frankford and Southwark road. This lease will carry with it the Frankford and Southwark's leased and operated lines, the Lehigh avenue, Citizens', Second and Third and Lombard and South. It is estimated that from $6,000,000 to $8,000,000 will be required to install the trolley on the entire system. The funds could have been raised in other ways, such as an additional issue of stock or by bonding the different roads, but the organization of a new company was considered the best method.

POWER TRANSMISSION.

Another company has been incorporated for transmitting power to San Bernardino, Cal. The name of the company is the Consolidated Reservoir & Power company and the capital stock is $1,000,000.

The great electric power transmission plant at Pomona, Cal., is now in successful operation. The generators are driven by direct coupled Pelton wheels, under a head of 400 feet at 600 revolutions per minute, and each generator delivers alternating current at a pressure of 1,000 volts to a bank of transformers by which the initial pressure of the line is raised to 10,000 volts. Circuits of bare copper, carried on special insulators, extend to the towns of Pomona and San Bernardino, the latter being 28 miles distant, where the power is being utilized for lighting and other purposes.

The mountains in Sweden are valuable because of their waterfalls. A large electrical transmission plant of 400 horse power is nearly finished in which a waterfall at Hull-See is utilized by means of four turbines. Two turbines drive dynamos for power purposes, one for electric lighting, the fourth being held in reserve. The distance to the first station is 10 kilometers, a second is 4 kilometers farther, the third is 1 1-2 kilometers still farther, and a fourth is a short distance from this. The second and third distribute the most current both for power and for light.

MISCELLANEOUS.

The electric power house, 527 Third street, Louisville, Ky., was burned May 3d. The loss is $150,000.

The South Yuba Water company is considering the proposition of furnishing Sacramento, Cal., with electric power. A survey has already been made from Roseville to Sacramento.

The electric plant of West St. Paul, Minn., was obliged to suspend operations recently owing to the high water in the Mississippi River. The building of the plant was flooded and damage to some considerable amount was done.

The Twin Cities Rapid Transit company's power house was the scene of a peculiar accident lately. Chas. Warren, chief clerk of General Manager Hield, was paying a visit to James Holstrom, who has charge of the switchboard in the dynamo room. Mr. Holstrom, in explaining lightning

arresters, in some way connected the circuit, blowing out the fuse. Both men were badly burned.

The eighth annual convention of the order of Railway Telegraphers of America opened its session on May 16th, at Toronto, Can. About 250 delegates, representing 253 divisions in the United States, Canada and Mexico were present.

The General Electric company is to build a large electrical factory a short distance from the city limits of Akron, O. This will bring it much nearer its base of supplies, and will be a great saving in freight. Options have been secured on ground, and a belt line railroad will be built to connect the plant with the neighboring railroads. It is understood that nearly 700 men will be employed in the works.

The Thomson-Houston company, Lynn, Mass., is endeavoring to discover the perpetrators of a species of vandalism of the worst class. In several instances it has been discovered that the fire apparatus in the company's factories has been tampered with, the hose cut, and extinguishing machines removed from their proper places. The company is making every effort to discover the authors of these offences, and as the punishment in such cases is five years' imprisonment and $1,000 fine, some one is liable to get into serious trouble.

According to the announcements of the committee having in charge the rebuilding of the Metropolitan Opera House, New York, a novelty in theater construction will be introduced in the shape of electric elevators of large capacity. To make the omnibus tier and the next two above it readily accessible, and practically to make one part of the house as good as another, four large electric elevators are to rise from one of the entrances of the house. They have a capacity of 100 persons a minute. They will stop at the grand tier, the dress circle and the balcony, but will not reach the family circle.

TRADE NEWS

E. C. French, representing the Babcock & Wilcox company of New York, established an agency at Deseronto, Ont., last month.

The address of the New York Electrical & Development company is 251 Williams street, New York City, and not 281 Madison street, as stated in the issue of May 13th.

W. C. McIntire & Co. and H. S. Smith & Co. of Philadelphia, selling agents for the Meston alternating fan motors, report very large sales during the month of May for these fan motors, and have a number of orders on hand for immediate shipment.

The Electric Heat & Alarm company, Boston, Mass., has completed equipping a large factory at Haverhill, Mass., with its system, and received within the past ten days three contracts from other large mills for the installation of its system at the earliest moment.

Owing to the number of electric bells on the market, it is very gratifying to Huebel & Mangen, manufacturers of electrical and brass goods, of Brooklyn, that their bells were placed in the new Hotel Waldorf on Fifth avenue, New York. This company is unusually busy with orders now on hand for its different size bells.

The name "Insullac" has now an associate in the word "Enamelac," which is the name the Massachusetts Chemical company of Boston, Mass., has given to its newly perfected black paint, especially adapted for car trucks, iron poles, conduits, batteries and machinery, and it announces to its friends in the electrical department that it is ready to supply the demand for this article.

Andrew Shillinglaw, of C. E. Woodruff & Co., Chicago, is making his presence felt among purchasers of wire. Fifteen miles of "canvasite" is the last order secured on a recent trip. "canvasite" is a wire with rubber insulation and canvas cover. C. E. Woodruff & Co. find that the trade fully appreciate the merits of this wire.

A circular has been issued to the creditors of the Detroit Electrical Works, requesting them to meet at the office of the company at the Campau Building, Detroit, on June 2d, at 10 o'clock in the morning. At this meeting an endeavor will be made to reach an arrangement by which all the creditors will ultimately secure payment in full.

Treasurer and General Manager H. N. Fenner of the New England Butt company of Providence, R. I., was in New York recently. Mr. Fenner is desirous of stating that the correct location of his company's exhibit at the World's Fair is T 12 electricity building, as some of the electrical papers have incorrectly reported its location.

H. L. Burdick, manager of the New York office of the National India Rubber company of Bristol, R. I., received last week a complimentary letter from Randolph & Sullinger, contractors of that city, who recently wired a seven-story office building on Water street with N. I. R. wire, in which they state that the wire showed a high insulation, notwithstanding the fact that the wire had laid for several weeks in wet plaster.

The following board of directors has been elected for the Electric Selector & Signal company of 45 Broadway, New York: Jennings S. Cox, Wm. E. Tillinghast, John Dougherty, Thomas Sturgis, James Brown Potter, Wm. C. Lane, Charles F. Homer, F. P. Voorhees, James M. Townsend, jr., C. P. Mackie. The officers are: President, Thomas Sturgis; first vice-president, Wm. C. Lane; second vice-president and general manager, C. P. Mackie; treasurer, F. P. Voorhees; secretary, James Brown Potter; general agent, S. S. Bogart.

Many indeed are the types of switches now being introduced, and there is a similarity in a great many of the new productions. When, however, a new switch is brought out that possesses ingenious features of simplicity and reliability in action the device is entitled to examination by users. Such a switch as this is now being manufactured by Cutler & Hammer, 313 South Canal street, Chicago. A personal inspection of this pattern of switch, it is believed, will convince the practical man that this enterprising firm is fully cognizant of the needs of the trade.

Station managers who realize the value of standardized fuse wire may be interested to know that the Wirt fuse wire handled by the Ansonia Electric company, formerly the Electrical Supply company, is standardized wire. The large sales which this company is making of shield brand wire, Stanley transformers and Helios lamps would tend to prove that it is a combination which operators of plants think very highly of. A neat little pamphlet has recently been issued descriptive of the W. W. lightning arrester, which ought to be of interest to every station superintendent or manager.

Word has been received from A. S. Terry, secretary and treasurer of the Star Electric Lamp company, Chicago, to the effect that the new Sunbeam gas lamp is proving its superiority. The Star company calls attention to the peculiarity of this lamp, viz., that it maintains its initial candle power throughout its life. The gas in the bulb has a tendency, the company claims, to build up the filament during the incandescence, and this action prevents the drop in candle power. Orders, Secretary Terry state, are coming in gratifying numbers, and purchasers of the lamp evidently appreciate its valuable features.

The Ries Electric Specialty company of Baltimore is busy getting out a new line of regulating switches for alternating current circuits on the principle of its socket. The new switches are designed to simultaneously control a group of lights on electroliers and other places where the individual lamps are arranged along the ceiling or are otherwise out of reach. They are being made in sizes varying from one to ten lights capacity, and larger sizes are in course of construction. They operate on the reaction principle, no current wasting resistance being used.

New York amusement seekers and actors during the hot summer months will appreciate the liberality of the management of the Fifth avenue theater when they feel the cool breezes that will make the theater a delightful resort. The house has been thoroughly equipped with fan motors and it has been found possible to conceal the fans and render them noiseless. The Lundell outfit was chosen particularly on account of its noiselessness. The boxes will have each an individual outfit and there will be a plentiful distribution of fans throughout the auditorium, stage and dressing rooms. The Interior Conduit & Insulation company, whose wiring system is installed in the building, furnishes the Lundell fan outfit.

The General Electric company has reprinted in a neatly bound little book the article that appeared in the *Forum* of February, 1893, giving in detail the history of the company and its business at the present time. Not only does the article give a passing glance at well nigh every feature of interest pertaining to this giant industry, but it summarizes the work done by the company in connection with the World's Fair. Not the least interesting of the contents are the anecdotes of men whose names are best known to the electrical fraternity and the public at large. The style displayed in the reading matter is easy and interesting, and the illustrations are significant of each portion of the General Electric company's business.

BUSINESS.

A. O. Schoonmaker of New York is now offering to the trade East India mica in the solid sheet form, which he claims is superior to any of the manufactured articles now offered to the trade for all insulating purposes.

The Weston Electrical Instrument company of Newark, N. J., is very busy filling orders for the large call for its ammeters and voltmeters for central station and isolated plants, and has been taxed to its utmost in the immediate shipment of instruments in receipt of orders from exhibitors at the fair.

W. W. Marcus of Philadelphia continues to have many calls for his auxiliary mouthpiece for telephones, which is in use in many places. This mouthpiece rotates, and can thus be brought to the level of persons of any stature without the slightest loss of sound. Mr. Marcus will exhibit at the World's Fair in Y 12.

The Railway Equipment company, Chicago, reports numerous contracts made for its type G overhead material during the last few weeks. Railways companies in Tiffiin, O., Racine, Wis., Norristown, Pa., Mobile, Ala., Hazleton, Pa., Wheeling, W. Va., Wichita, Kan., and numerous other places throughout the country have made heavy orders.

Lucius T. Gibbs, formerly electrical engineer of the Milwaukee Street Railway company, has resigned his position to engage in the consulting engineering business and is located at 1103 Pabst building, Milwaukee. Mr. Gibbs bears flattering testimonials from the Milwaukee Street Railway company and Senator William F. Vilas as to his ability.

The Electric Appliance company, Chicago, is showing a very attractive line of Meston alternating current motors for special work at its World's Fair exhibit, space U 16. The Emerson company, manufacturer of the celebrated Meston motors and for whom the Electric Appliance company is the general western agent, has made some new applications of its motors this season and now has its alternating motor applied to a dental outfit and also as a sewing machine motor both being practical combinations. Another specialty of this season is its revolving motor which is a very ingenious piece of mechanism and a motor which promises to be very popular for ventilating purposes.

ELECTRICAL PATENTS.

Issued May 23, 1893.

497,771. Electric Heater. Samuel M. Cook, Boston, Mass.

497,790. Electric Broiler. Samuel B. Jenkins, Boston, Mass.

497,791. Electric Radiator. Samuel B. Jenkins, Boston, Mass.

497,792. Electric Flat-iron Heater. Samuel B. Jenkins, Boston, Mass.

497,793. Electric Soldering Iron. Samuel B. Jenkins, Boston, Mass.

497,794. Electric Heater for Flat-irons or Other Articles. Samuel B. Jenkins, Boston, Mass.

497,795. Electric Heater. Samuel B. Jenkins, Boston, Mass.

The electrical conductor is composed of metallic and non-metallic conductors, occupying alternate positions, with their ends held in contact by pressure, advantage being thereby taken of the heat produced in the passage of the current from a metallic to a non-metallic body.

497,800. Thermostat. Emil C. C. Krogh, Monmouth, Ill.

497,808. Railroad Rail and Process of Uniting Same. Arthur J. Moxham, Johnstown, Pa.

In order to effect a uniform weld throughout the entire cross-section of the pieces to be welded, the ends are so formed that the thinnest portions come in contact and are welded first, the remaining portions being brought in contact by upsetting the welding portion.

497,832. Electric Mining Machine. Elmer A. Sperry, Chicago, Ill.

497,836. Safety Block System for Railway Signaling. William R. Sykes, Jr., and John P. O'Donnell, London, Eng.

497,838. Safety Appliance for Systems of Electric Distribution. Elihu Thomson, Lynn, Mass.

The invention is designed to render normally low tension lines harmless when through accident they become crossed with a line of high tension. A connection to ground is established from the low tension line through an insulation, such that the normal low tension current is unable to pass, while a passage of a high tension current is permitted, thereby opening a low resistance path to ground, and shunting the high tension current to ground past the body of the person who may come in contact with the line. The insulation consists of a pair of electrodes normally separated from one another by a space containing an attenuated gas or vapor, the high tension current being adapted to traverse the space to close the low resistance circuit to ground.

497,844. Electrical Fuse-link. Marion C. Walls, Plymouth, Ind.

497,849. Wall Socket for Incandescent Lamps. Herbert C. Wirt, Boston, Mass.

497,852. Insulation for Underground Wires. Parvin Wright, Denver, Colo.

The conductor is centrally supported in a tube by means of longitudinally divided insulating pieces, the air being withdrawn from the tube and the same hermetically sealed.

497,869. Electric Accumulator. Paul J. R. Dujardin, Paris, France.

The accumulator plates are formed by decomposing a proportion of alkaline nitrate by an electric current in an acidulated bath, whereby an adhering layer of peroxide of lead is produced upon the plates.

497,887. Armature for Electric Motors or Generators. James F. McLaughlin, Philadelphia, Pa.

497,888. Electric Motor or Generator. James F. McLaughlin, Philadelphia, Pa.

497,898. Electrode Shield for Arc Lamps. Charles E. Scribner, Chicago, Ill.

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497,923. Thermostatic Instrument. Morris Martin, Malden, Mass.

497,942. District Telegraph Return Signal Key. John M. Bell, Tacoma, Wash.

497,955. Temporary Circuit Connector for Incandescent Electric Lamps. Gustav A. Frei, Springfield, Mass.

497,956. Incandescent Lamp. Gustav A. Frei, Springfield, Mass.

497,957. Incandescent Electric Lamp. Gustav A. Frei, Springfield, Mass.

A support is provided for the filament, and is secured to the base of the lamp between the leading-in wires, extending forward between the two limbs of the filament, where it bends at right angles, being provided upon its end with a loop adapted to encircle one limb of the filament to prevent the vibration of the filament.

498,022. Electric Current Time Meter. Henry H. Pattee, Monmouth, Ill.

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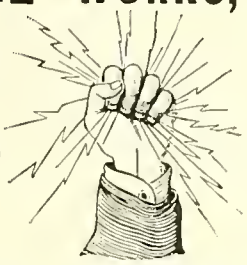

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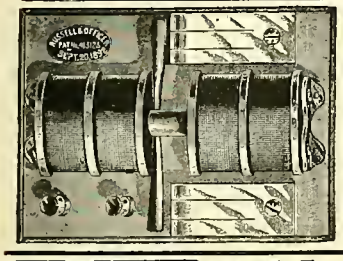

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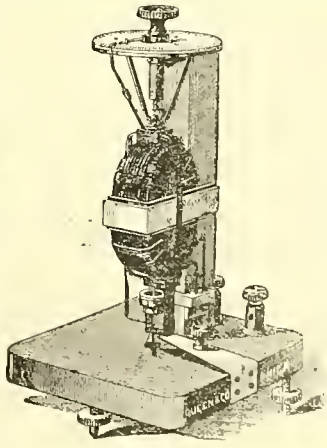

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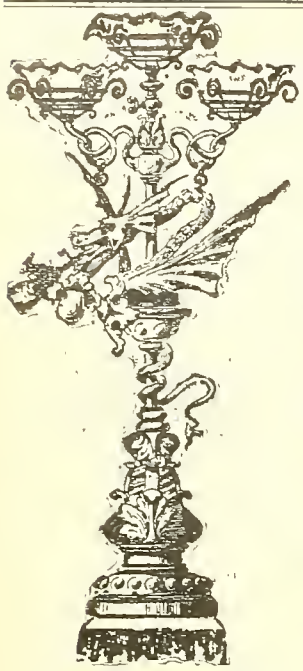

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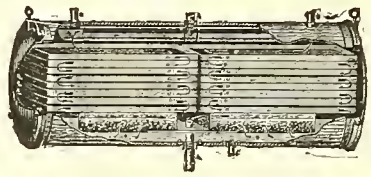

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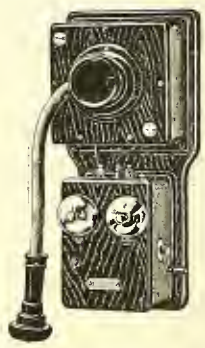

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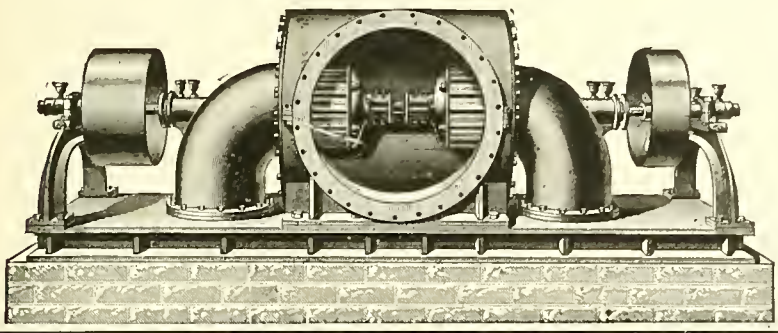

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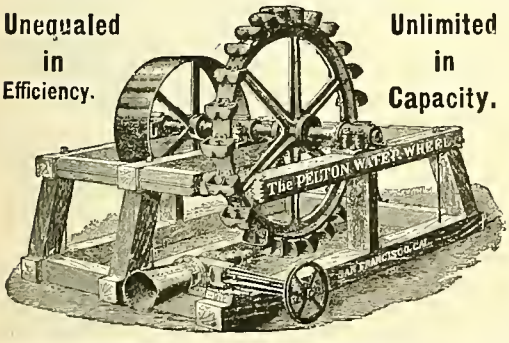

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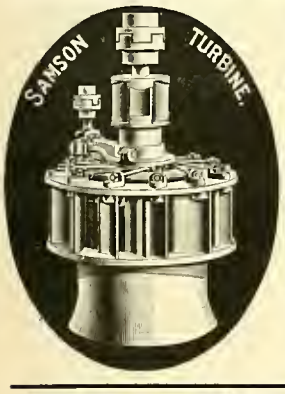

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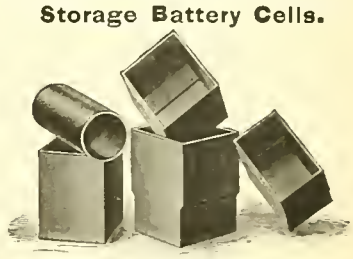

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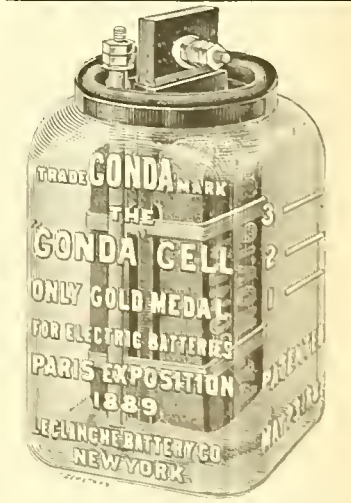

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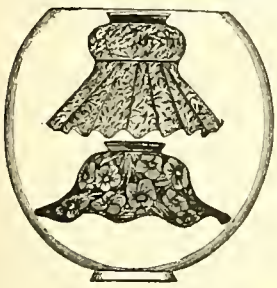

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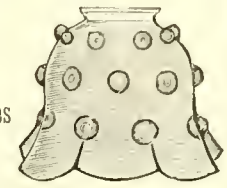

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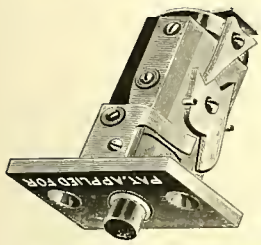

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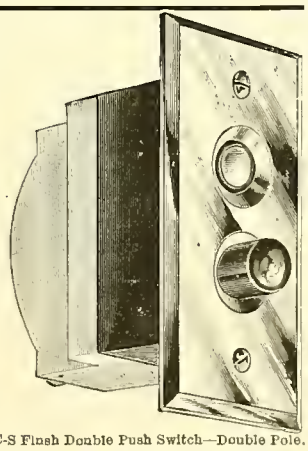

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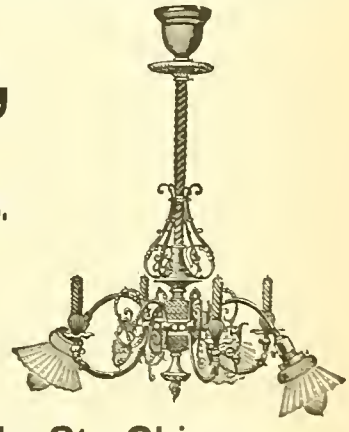

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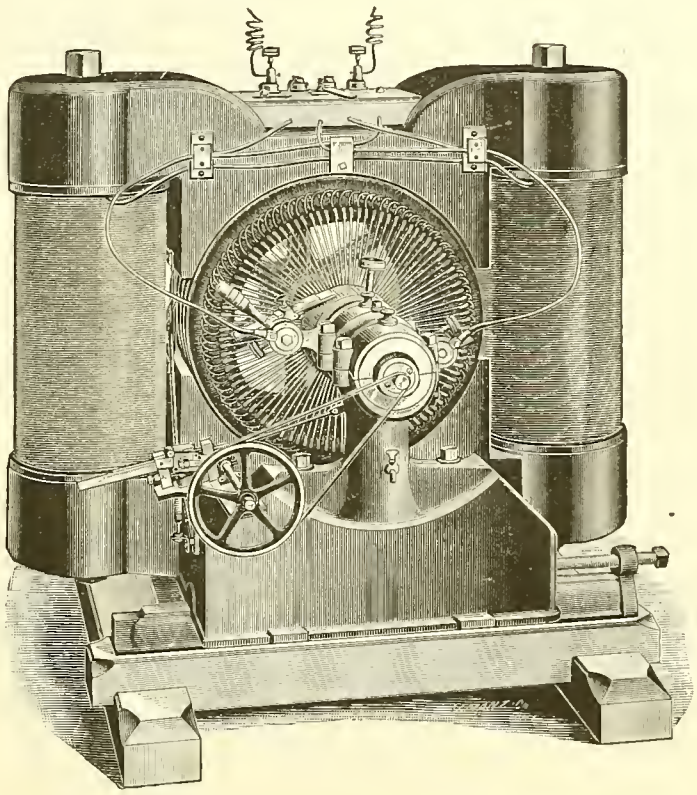

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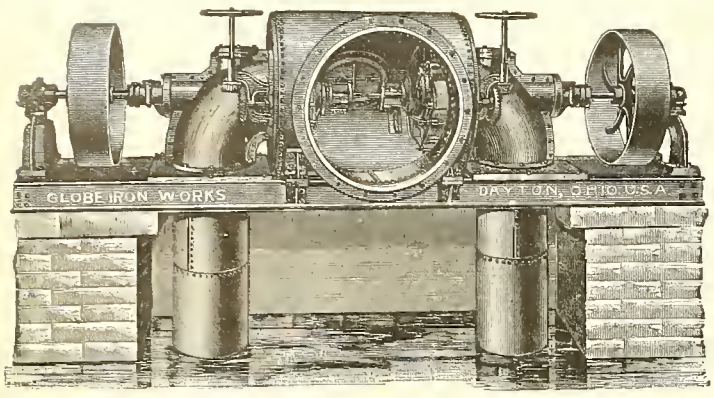

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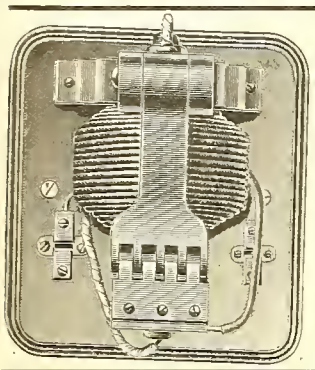

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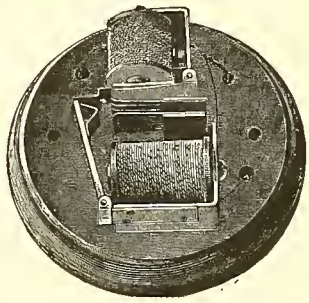

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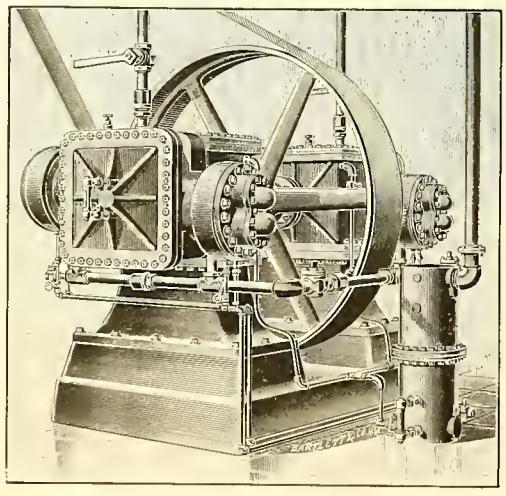

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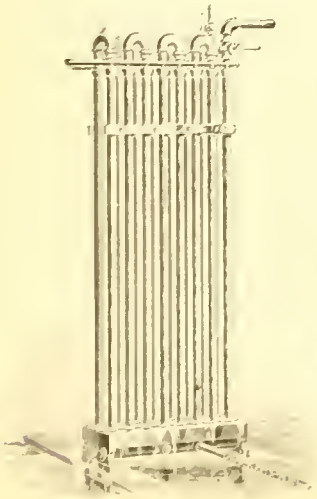

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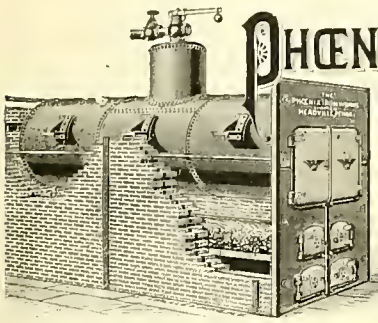

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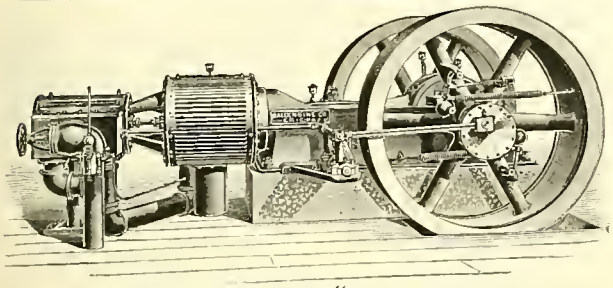

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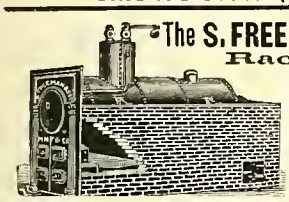

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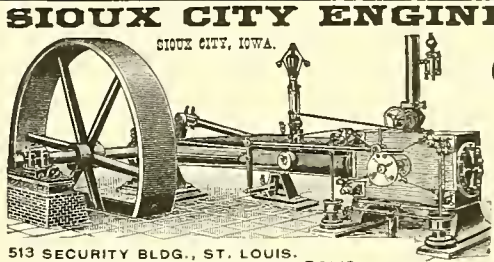

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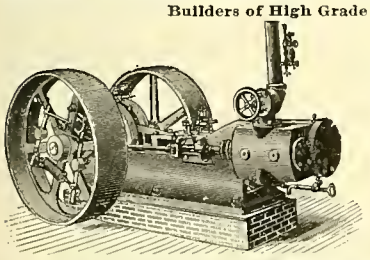

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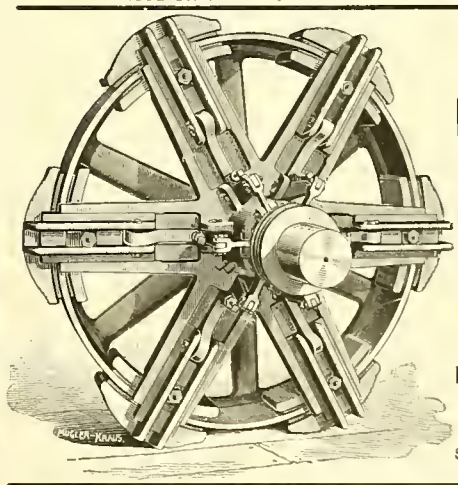

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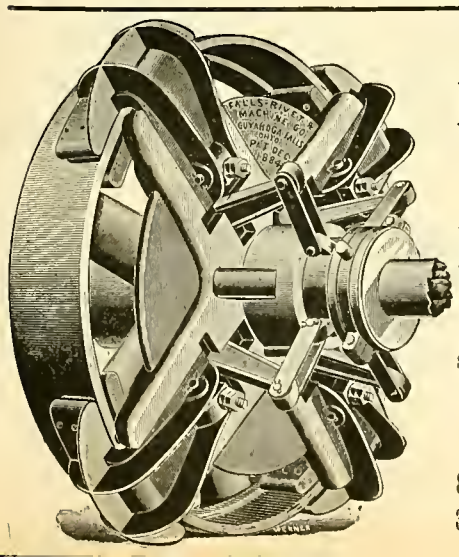

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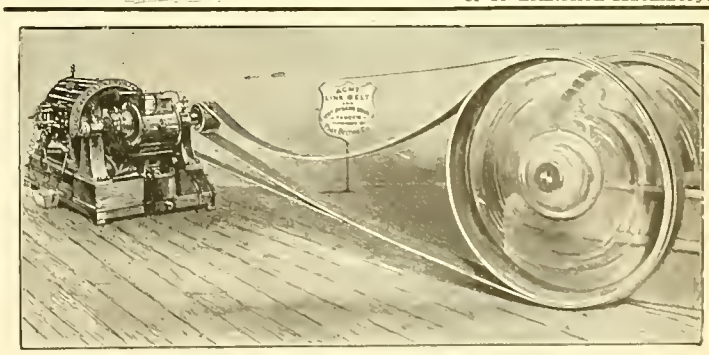

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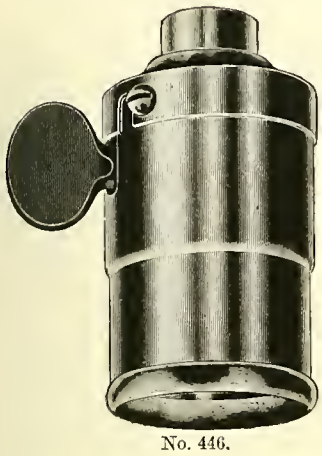

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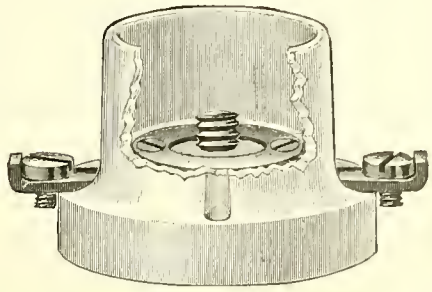

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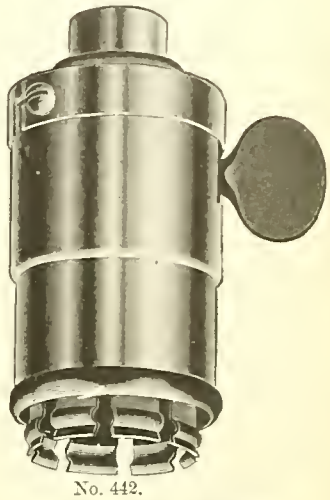

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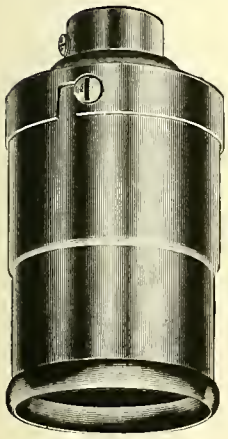

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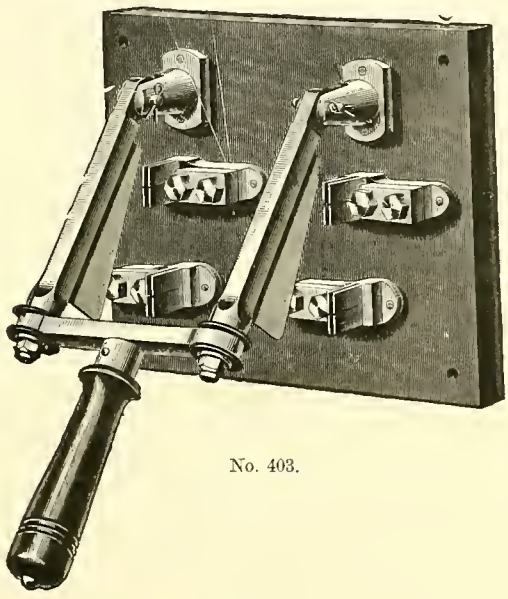

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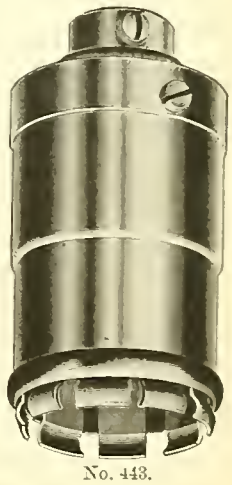

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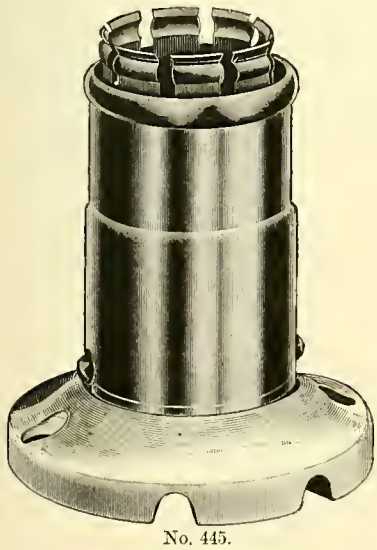

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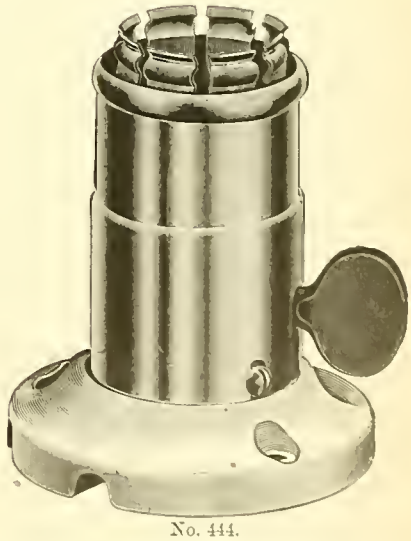

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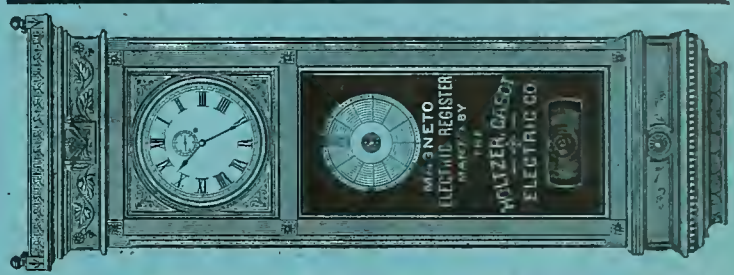

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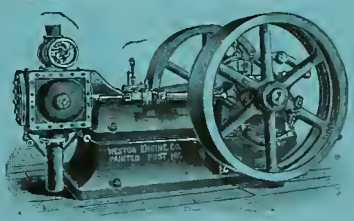

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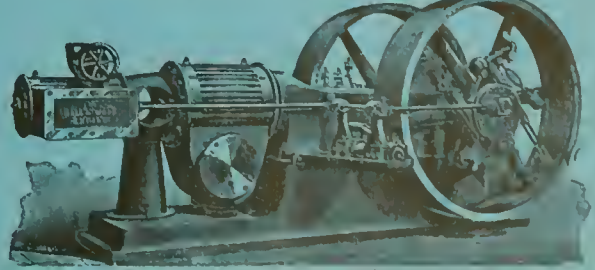

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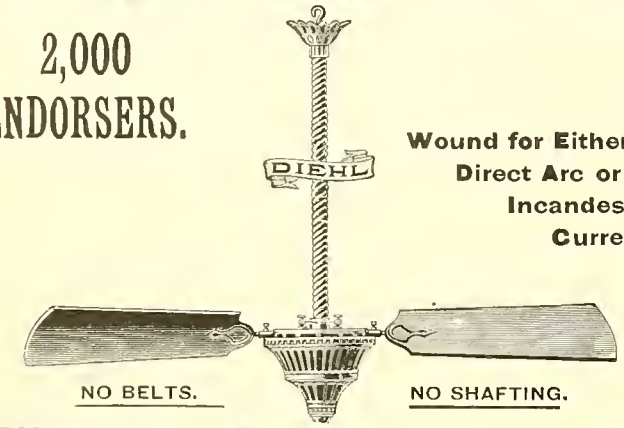

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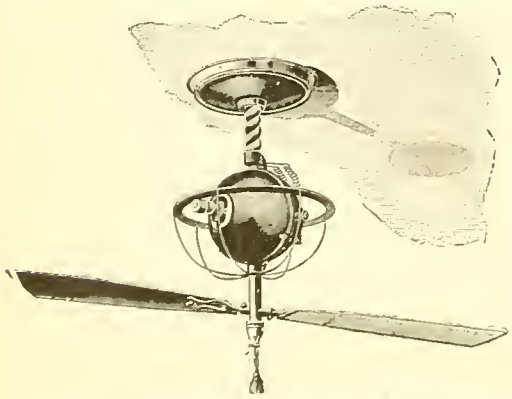

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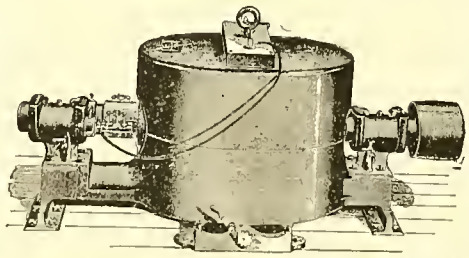

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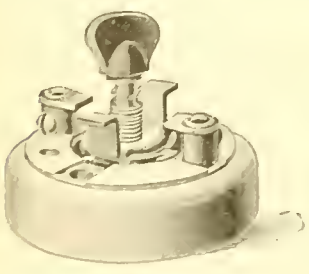

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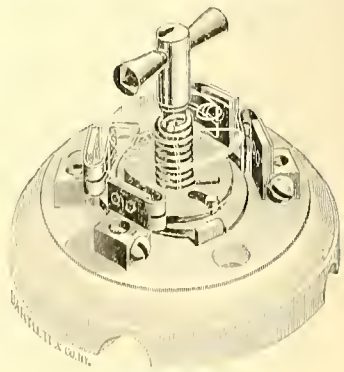

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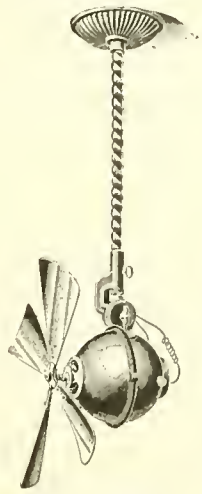

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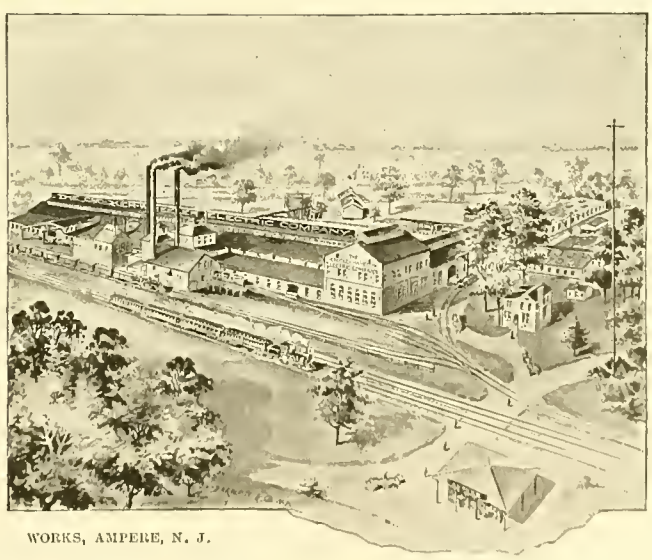

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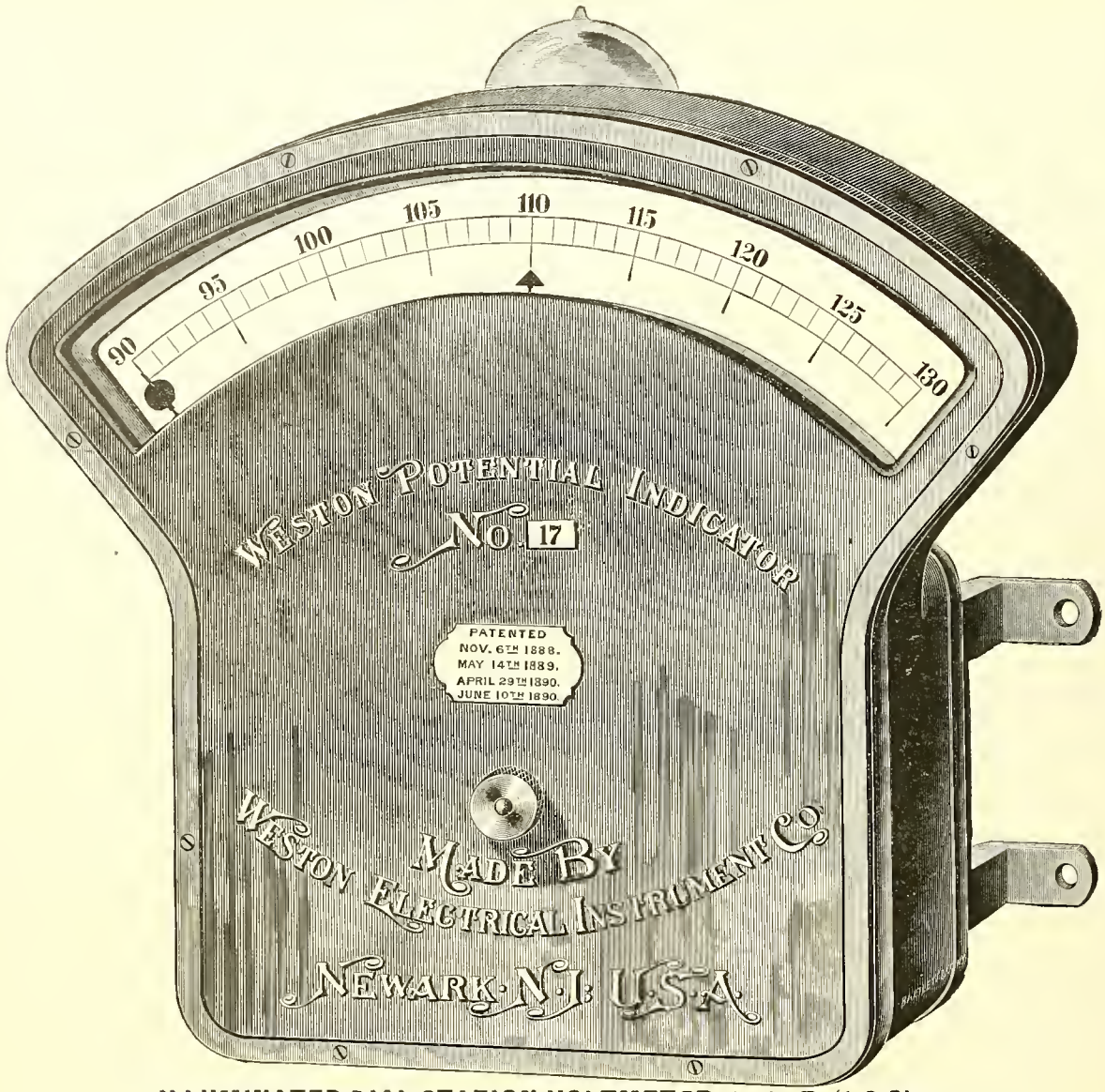

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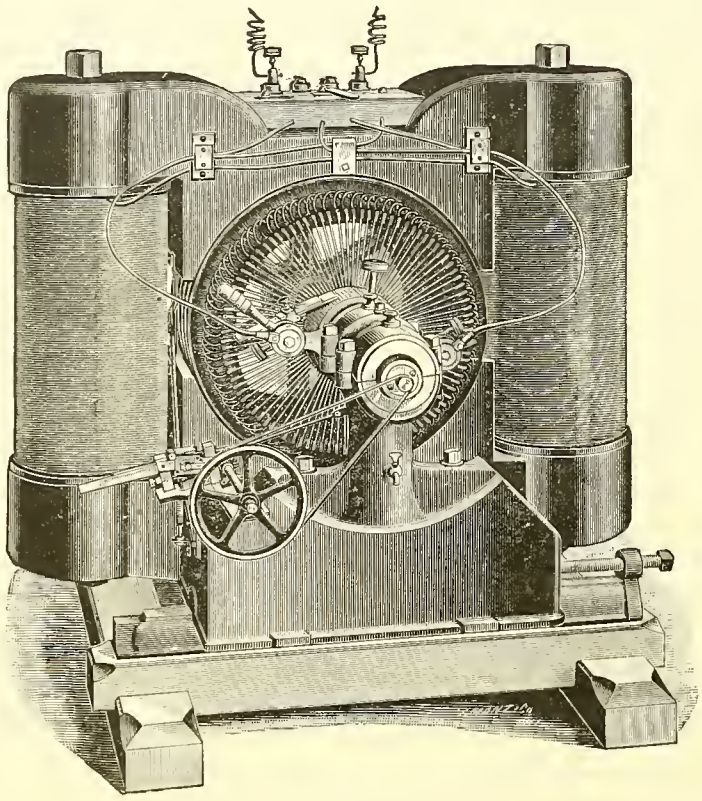

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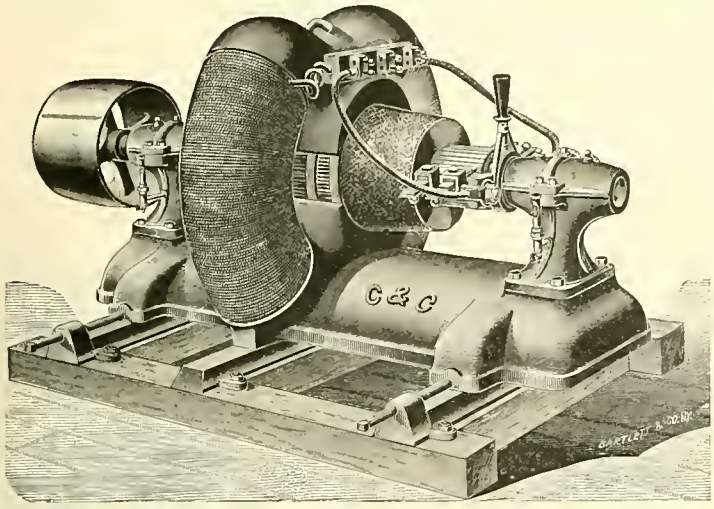

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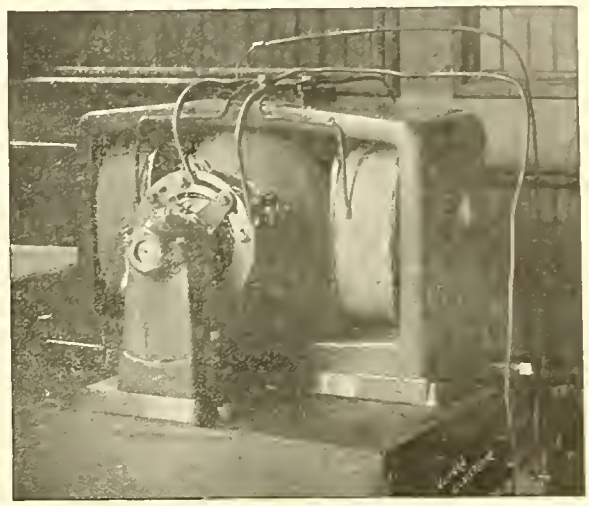

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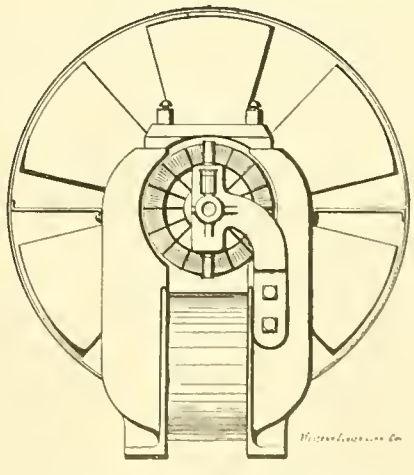

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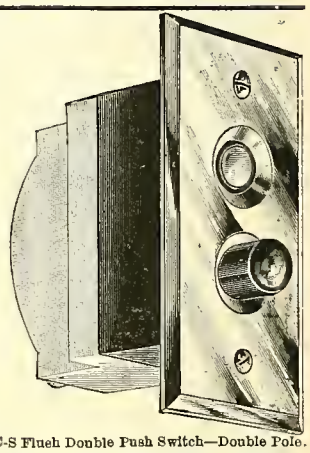

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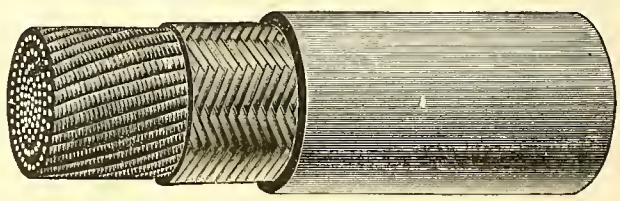

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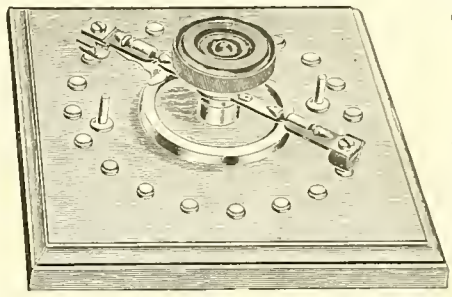

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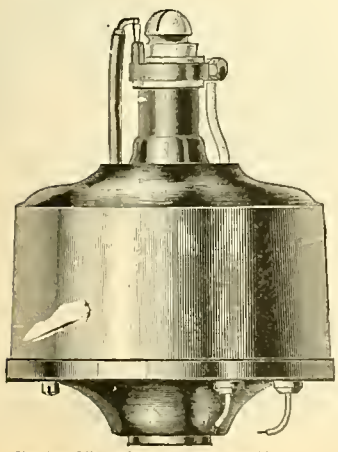

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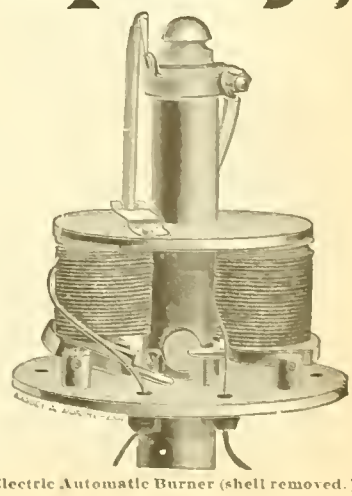

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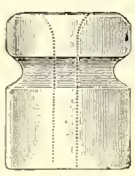

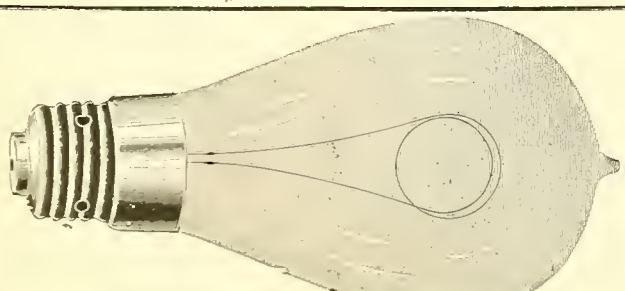

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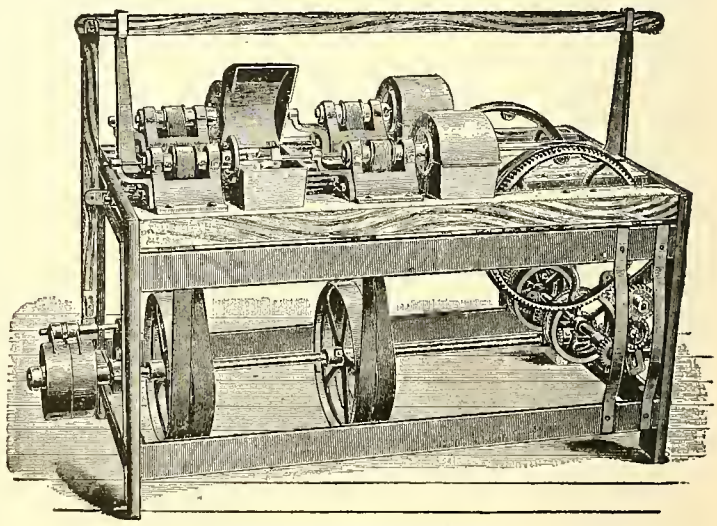

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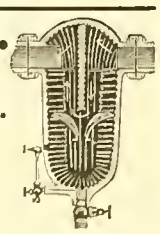

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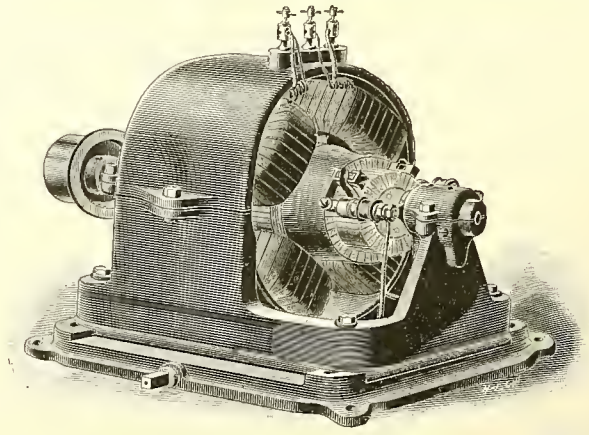

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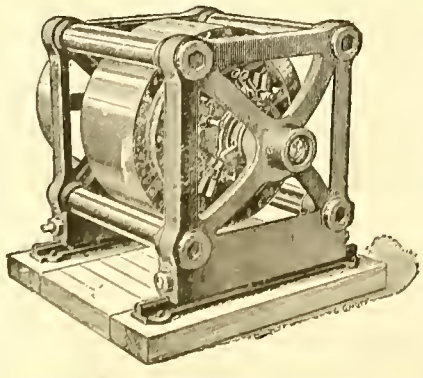

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Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, JUNE 10, 1893. No. 23

Electricity at the World's Fair.

Of course the event of last week in electrical circles at the World's Fair was the formal opening of the electricity building on Thursday night, and it is gratifying to be able to announce that the affair proved to be a conspicuous success. The drawing power of the electrical display was shown by the throng attracted by the announcement that all the spectacular effects in the building would be on view. There were about 70,000 people admitted to the gates during the day and evening, despite the rainy weather, and it was believed that from one-third to one half of these were drawn out solely by the announcement that the strange sights prepared for the public in the electricity building could be seen. At any rate every aisle of the great building was well filled with surging humanity during the evening, and many thousands witnessed the display, although the electric illumination about the grounds was unusually elaborate.

Although several exhibits are still incomplete, the general display, taken as a whole, was in a finished state, and the building presented by far the finest appearance that it has yet made. Early in the afternoon the aisles and exhibit spaces were cleared up, in pursuance of orders from Chief Barrett, and decorations in the shape of flags and potted plants were added. At eight o'clock, which was the hour fixed for the beginning of the illumination, the interior of the building presented a brilliant appearance. There was light, light everywhere, from hundreds of arc lamps and thousands of incandescents. Sousa's band was stationed in the east transept of the gallery and furnished excellent music during the evening, which greatly added to the enjoyment of the visitors, as they slowly passed about the building admiring the brilliant spectacle.

Of course the central attraction was the Edison light tower, which was exclusively illustrated in the WESTERN ELECTRICIAN last week. This was unveiled about eight o'clock, and when the graceful outlines of the column stood revealed there was a general "oh!" of surprise and admiration. The lighting was begun almost immediately, and lines of red, yellow and purple light were soon succeeding one another on the glistening white surface of the column, while all the time and over all the great prismatic bulb glowed with the light of many miniature lamps contained within it. Below, in the colonnade, was a flood of white light from a large number of artistic glass fixtures, and, taken altogether, the effect was very fine. When all the vari-colored lamps on the column and on the roof of the colonnade were burning together the effect was most beautiful, and the only criticism that can be advanced is that the volume of light in the lofty prismatic bulb was insufficient to fully bring out the beautiful effects possible with the myriad facets of this carefully built structure of glass. Doubtless this defect will be remedied. The switches in the base of the column were manipulated by E. W. Hammer, and he adapted the lines and waves of light to the surging rhythm of the music. During the periods when the lights on the shaft were extinguished the tower was illuminated by small search-lights placed on either side of the building.

But although the Edison tower was the principal attraction it was far from being the only one. The golden Westinghouse pavilion was lavishly lighted with incandescent lamps, and just north of it the great light house reflectors of the French revolved slowly and impressively. To the south the large Bell telephone pavilion was beautifully lighted, while the spectacular Western Electric display drew a great throng, with its gorgeous Egyptian temple, the popular column of light and "lightning," the "writing finger" and other novelties. In the gallery the principal spectacular displays were those of the H. W. Johns Manufacturing company, the New York & Ohio company and the K. A. P. Electrical Novelty company.

FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.—COLUMN OF LIGHT AND "LIGHTNING," ELECTRICITY BUILDING.

Chief Barrett, Mr. Hornsby and the officers of the department of electricity worked diligently to make the opening the success it proved and were naturally elated at the gratifying result. After the throng had dispersed an informal luncheon was given in the office of the department by Chief Barrett, which was attended by a few of his most intimate friends. The chief was the recipient of many congratulations. But one accident happened to mar the pleasure of the occasion, and that was a small fire in the pavilion of the Weston Electrical Instrument company about 9 o'clock. The blaze was started during the temporary absence of Mr. Heinrich, and its origin is not known. The flames mounted up one side of the structure in lively fashion, and for a few moments the fire threatened to become serious, but a volunteer fire department was instantly organized, and with the assistance of a stream from a stand-pipe and line of hose the flames were speedily extinguished, largely through the efforts of Superintendent Blaisdell, A. P. Eckert and Mr. Paiste. Considerable damage was done, however, especially by water, which, coming in unexpected volume and strength, not only put out the fire, but also destroyed the self-poise and disarranged the raiment of many of the spectators. Altogether, the night was an eventful one, and it will long be remembered.

In Fig. 1 is illustrated what visitors find one of the most pleasing sights in the electricity building — the Western Electric company's column of light, with the "lightning" streamers radiating from the top. The column is studded with over two thousand red, white and blue incandescent lamps, and as the broad band of light rises from the base and darts along the zigzag streamers the effect is very striking. Revolving balls of fire are suspended from the ends of the streamers, but are not shown in the illustration. An automatic revolving switch cuts the lamps in and out of circuit. This device can be seen by looking into the boxed-up pit shown at the right of the column, and it is usually surrounded by a throng of spectators. A corner of the Western Electric company's Egyptian temple is shown at the left, and the close observer will notice upon it delineations of ancient Egyptians engaged in such extremely modern occupations as trimming arc lamps and climbing telephone poles. A full description of this very attractive exhibit was given in the WESTERN ELECTRICIAN of May 20th.

Directly west of the Western Electric exhibit is the large pavilion of the American Bell Telephone company, illustrated in Fig. 2. This structure, which is severely Greek in architecture, is the largest pavilion in the building, and has been criticized as being out of proportion to its surroundings and as obstructing the view from the

south. The design of the building itself, however, possesses great intrinsic merit, and is generally commended. It was made by the architects of the agricultural building, which, from an architectural point of view, has disarmed all critics. The Bell pavilion contains a complete exposition of the telephone, from the crude instrument shown in the early patents to the long-distance system of to-day. It is also the headquarters of the World's Fair exchange, and the girls make the connections in full view of the spectators. Interesting statistics of the growth of the business, as well as models and drawings, are shown, and the central portion of the building is devoted to a telephonic concert room.

An illustration of the showy little display made by the K. A. P. Electric Novelty company of LaCrosse, Wis., and mentioned before is presented in Fig. 3. This company has a patent socket especially designed for rapid wiring in case of temporary illumination for celebrations and the like. It is claimed for it that by its use a wireman can wire ten times as many lights in a day as he can with ordinary sockets, and also, from the flexibility and construction of the socket, that it is particularly adapted for use in revolving designs and sign work. The use of the socket is illustrated in the exhibit, where a number of colored lamps are wired on a revolving belt, the effect being novel and striking when the belt is in motion. Contact is made with two copper strips on one of the pulleys on which the belt revolves, current being taken from an ordinary incandescent circuit. The pulley is made to revolve by power from a $\frac{1}{8}$ horse power Thomson-Houston motor. Another feature is a revolving globe, with the outlines of the various countries indicated by miniature incandescent lamps. The company also exhibits an electric cautery and rheostat for surgeon's use and designed for incandescent circuits. The cut, Fig. 4, shows the construction of the device and further explanation is hardly necessary. The apparatus can also be used for burning small surgical lamps of low voltage, such as are used for examining the throat and other cavities of the body. The display is located near the center of the eastern gallery.

The exhibit of the E. S. Greeley & Co., in the northeastern corner of the building, on the ground floor, which has heretofore been briefly described in this paper, continues to attract a large number of visitors, who take especial delight in lingering over the gold and ivory telegraph key which was pressed by President Cleveland to set the Allis engine and electric fountains in motion on the opening

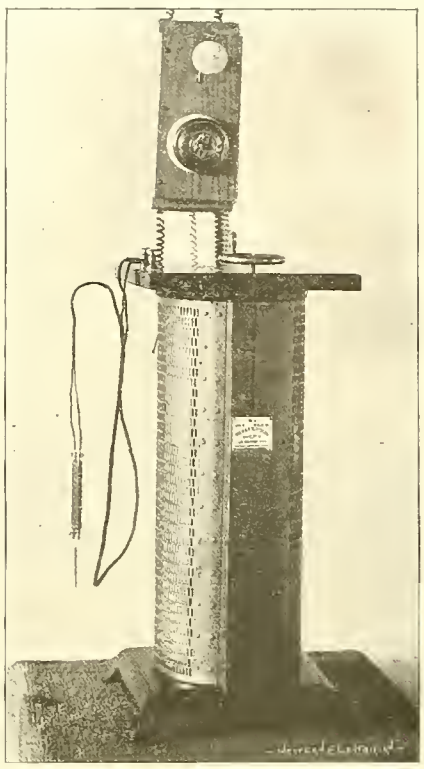

FIG. 4. ELECTRICITY AT THE WORLD'S FAIR.—SURGEON'S ELECTRIC CAUTERY, ELECTRICITY BUILDING.

day. A view of the principal portion of the exhibit is given in Fig. 5. Louis J. Auernacher is in charge.

The rooms of the American Institute of Electrical Engineers, which are on the gallery floor of the electricity building, facing the southern hemicycle, have been tastefully fitted up with rugs, curtains, portieres, chairs and tables and will soon be open for the reception of visitors. The committee having in charge the arrangements for the rooms has not been idle, and W. J. Hammer, the chairman, makes the gratifying announcement that a number of interesting historical exhibits will be shown. Among these will be the apparatus by which Prof. Ferraris of Turin, Italy, made the first demonstration of a rotary field by means of alternating currents differing in phase. A piece of the circuit over which the first electric telephonic message was transmitted will be shown and also interesting historical relics of Franklin and Morse. Of contemporary electricians Elihu Thomson, Houston, Berliner, Edison, Van Der Weyde, Gray, Tesla, Sprague, Wallace and others will contribute. There will also be a fine collection of portraits of American and European electrical investigators. Altogether, the rooms will possess great intrinsic interest, aside from their convenience as a meeting ground for the members of the electrical fraternity.

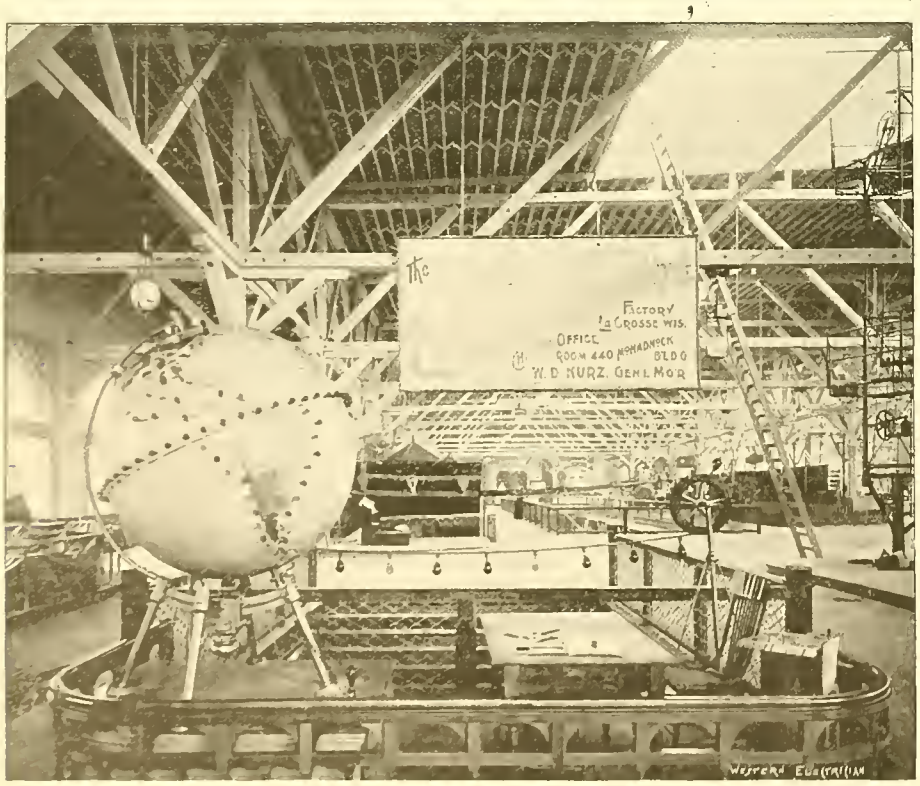

FIG. 5. ELECTRICITY AT THE WORLD'S FAIR.—NOVEL WIRING EXHIBIT, ELECTRICITY BUILDING.

The wiring for the service lighting at the World's Fair is now very nearly completed. Of fixed incandescent lights, exclusive of lamps furnished on special orders for exhibitors, 52,387 have now been wired, while 4,500 arc lamps are now ready for service, including about all those located in or north of the machinery and agricultural buildings.

The illumination of last Saturday evening was rendered notable by the fact that the big Schuckert search-light on the northwestern corner of the manufactures building was operated for the first time. Although no tests were made to demonstrate the strength of the light, the great beam attracted much attention from the visitors present.

One of the very first exhibits in electricity building to be completed was that of the Belknap Motor company of Portland, Me., which is illustrated in Fig. 6. The company has a complete display of its dynamos and moters, power being furnished by a 10 horse power motor operating on a 220 volt circuit, which drives a 100 light dynamo that furnishes current for arc and incandescent lamps, exhaust fans, a revolving sign and coffee mill motors. One interesting novelty is an electrically operated drill for use in iron work. The device is provided with a powerful electromagnet by which it can be instantly attached to a boiler or other iron surface and strongly held in position for the work to be done without other fastening. The magnetism holds the drill so firmly that a strong man cannot pull it away from the iron, although, when necessary, the machine can be easily removed by a twisting motion instead of a direct pull. The Belknap company's exhibit, which is located on the ground floor of the building, in the north eastern portion, is in charge of George W. Brown.

The lamp collection from the Edison lamp works is one of the most valuable and instructive in the building, while at the same time possessing great interest to the average sight seer. It can be found in the General Electric company's space, just north of the tower of light. Here are to be seen incandescent lamps of all sizes, shapes and colors, comprising in all nearly 2,500 specimens, many of them very rare and curious. No two lamps are shown in duplicate. The collection is arranged in cases, three of which are devoted to the fibrous growths experimented with by Edison when he was in search of the best material for the incandescent lamp filament. These products represent trips all over the world and an expenditure said to have reached $200,000 before the great inventor found what he was seeking in a Japanese bamboo, now cultivated on special plantations. The steps in glass working necessary for the production of the lamps are shown in several cases, while one is devoted to the Edison patents and another to the tools used in making the first "tar-putty" lamp. Of the "regular" types of lamps the ordinary standard lamp of all voltages and candle powers, municipal, railway and marine lamps are shown, while a bewildering array of "special" forms is exhibited, from those of a fraction of a candle power, giving just a pin-point of light, to a big multiple carbon lamp of 250 candle power. Some of the "special" forms are very odd, such as the door-knob type and the lamp with zigzag filament. The miniature lamps, also, assume grotesque forms and adopt all the hues of Joseph's coat. Special lamps are also shown which are used for purposes of resistance by the Western Union Telegraph company, and the display of experimental and historical lamps is very large and highly interesting. Those who are interested in electric lighting will find no more instructive display at the fair than this comprehensive and valuable exhibit.

One who has an appreciation for humor need not go outside the electrical features of the exposition to find mirth-provoking inscriptions. Thus one handsome pavilion in the gallery of electricity building bears this warning:

Do not throw packing cases against this pavilion.

The writer evidently held, and not without some show of reason, that a man who would throw packing cases at a pavilion was no gentleman. Another exhibitor whose display was almost entirely hidden by some ugly scaffolding put up by sign painters covered up his exhibit and then posted this sarcastic notice:

TO THE PUBLIC.

We will re-open our booth just as soon as these artistic decorations are removed. H. T. PAISTE.

But it was reserved for a German exhibitor in the manufactures building to tell his woes in English verse. One dark room in the section devoted to the Fatherland is decorated with this legend:

This room will be bright at day and night
As soon as Mr. Pierce gives us electric light.

That certainly tells the story with precision and grace.

The technical press is well represented in the electricity building. Among the out-of-town newspaper men who have paid recent visits or are now in attendance at the exposition are E. R. Dolby of *The Engineer*, London; W. J. Johnston and Nelson W. Perry of the *Electrical World*

New York; Charles W. Price of the *Electrical Review*, New York, and George B. Muldaur of the *Electrical Engineer*, New York.

Electric Heating.[1]

By S. B. Jenkins.

The extensive use of heat, in the economy and comfort of daily life, is seldom observed; and the expense of and labor incidental to the varied applications still less frequently estimated. The importance of heat is readily perceived upon reflection, but the exact estimation of its cost is a matter of considerable difficulty in common practice. There are three distinct and available agents for the generation of heat for domestic and industrial purposes, viz.: coal, gas and electricity. It has been stated by Tyndall that he was able to obtain from the combustion of coal in the best range a useful effect of 6 per cent., and that the average of domestic practice was 3 per cent. The combustion of gas gives a considerable higher efficiency, but its use is not at all commensurate with coal. In the generation of heat from electricity, an efficiency in the production of useful effect is realized, vastly greater than either, and with which they can never possibly compete. The perfection of conversion, the unvarying quality, the ease of precise estimation, and the ability to absolutely localize and control the exhibition of the heat of electricity are unique and decisive points of superiority.

Ethically the rheostat is an electric heater, and has been the inspiration of many inventions in electric heating, but the invention of numerous electric heaters, as such, has resulted in their being set apart as a distinct type of electrical apparatus.

While the fundamental principle of this conversion was understood, the early apparatus for the conversion, exhibition, and utilization of the heat, in the production of useful effect, was crude and inefficient; the idea seeming to prevail that it was only necessary to pass the current through a resistance, and the full effect must be realized, the intimately involved principles of radiation, conduction, and convection having apparently been omitted from consideration.

The first United States invention of record in this field was made by G. B. Simpson in 1859. The earliest authentic electric heating in this country, so far as can be ascertained, was that done by Prof. Moses G. Farmer, who asserts that he heated his house in the year 1867 with an electric heater on the lines of a rheostat.

Some less noteworthy and abortive attempts were made later by others, but it is only within five years that systematic attempts have been made to put electric heating on a commercial basis with any degree of success. This delay is the fault of neither the inventor, the capitalist nor the the electric heater, but is the result of conditions; for obviously, when produced from batteries, electrical energy was too expensive to be used in the very limited quantities called for by electric lighting, and entirely prohibitive as regards its use for heating; not, however, on account of any inefficiency in the conversion into heat, for the incandescence lamp of to-day has an efficienc, of 5 per cent., with a loss of 95 per cent., and in the electric heater these figures are practically reversed.

The introduction of the dynamo, with the consequent increase of the volume of current and decrease of cost, gave a powerful impetus, first to lighting, then, as station capacities increased, to the distribution of energy to motors, and finally, heating.

Owners and managers of generating plants perceive that if electric lighting and heating are on a similar basis, the output is from forty to sixty times as much for heating as for lighting, and that the load line, when the energy is furnished to lights, motors and heaters will be much more uniform. The heating of churches on Sunday would come when the lighting and motor load was very small. It remains to determine the commercial status of electric heating, which includes its operative advantages and cost.

The production of large volumes of electrical energy from water power has resulted in a demand for the electric heater in utilization thereof. A number of proposals have been received from established power plants to furnish energy at a definite price under definite conditions; such were the price and conditions that electric heating was much cheaper than any other method, and in every way beyond competition.

It requires some time to assimilate the idea of running two large generators for sixteen consecutive hours to heat one building simply, for the turning on of electric lights in that building would be merely an incident and would not appreciably increase the load; this, however, is precisely where we are to-day when water power in abundance is within ten or more miles.

In many of the small articles, such as smoothing irons and cooking utensils, any arrangement for varying the heat involves useless complications, or, on the direct circuits, the wasteful generation of heat in an external resistance.

It is sought to produce heat only when needed, and to apply it only and exactly where its useful effect will be greatest. This is the secret of the present success of electric heating.

Ovens, the service hot water boiler and some other continuously operated apparatus are constructed so that the temperature can be varied within wide limits, without the use of an exterior resistance.

In heating houses, offices and buildings generally, the heat may be made exactly proportional to the necessities, and admit of wide variation at pleasure.

One large city house that has been heated since the fall of last year has a large primary heater in the cold-air duct where the displaced hot-air furnace stood, and just below where the feeder pipes branch off to the risers; this heater is controlled by a switch close by.

Just within the register openings to the rooms above are located smaller "reheaters," each controlled by a switch in the appartment. In the early fall or late spring, when a gentle heat only is desired, the large primary heater is run; when more heat is necessary, the "reheaters" are turned on. Should heat be required in moderate weather, in only one appartment, it is instantly at hand without affecting other rooms.

Sectional radiators are constructed of the same general design as steam apparatus, together with stoves and portable heaters of every desirable size and style; and the first cost of this heating apparatus is in general terms not more, and often less, than ordinary apparatus doing similar work in a much inferior manner; for there is no odor, dust or gas, no coal pile, no ash sifting, no attendance of account, but there is absolute control and knowledge of exact cost.

A complete equipment for the kitchen, laundry and butler's pantry is provided, with which all the domestic operations may be conducted with perfect certainty and cleanliness, in less time and with half the labor incidental to old methods.

Beef is roasted at the rate of seven to seven and one-half minutes to the pound, and the quality of the work is only excelled by the ease of its performance. The heat, which is largely radiant and of great intensity, is produced evenly all around the oven, the effect being so perfectly uniform that it is not necessary to baste the meat or to turn the bread or cake while cooking.

Broiling is difficult under ordinary circumstances, as an intense clear fire is required, and care must be used to avoid smoking the meat, as that gives it a bitter flavor; the electric broiler meets all requisitions perfectly and easily, and steaks and chops are cooked in the usual time to the delight of connoisseurs.

Tea and coffee pots, of all styles, making the decoction from "the cold" in from six to ten minutes, of perfect quality, steam cookers, stew-pans, spiders, etc., are provided to meet all demands.

The domestic supply of hot water is furnished from the electrically heated copper service tank or a heater attached thereto.

The first cost of this equipment is about the same as that of the ordinary outfit.

As the laundry irons are not set on a stove they may be kept perfectly clean. The heat is an effective so-called "live heat," without the attendant discomfort in a hot day of a highly heated stove.

A variety of apparatus for industrial use is shown, such as soldering irons, devices for brazing and soldering, electrically heated muffles, and smoothing irons for tailors', dressmakers' and hatters' use. These are all simple, easily operated, and partake of the general advantages and have individual features of excellence. Electric tram-cars are heated equably and comfortably without difficulty.

All apparatus is constructed for operation on either direct or alternating circuits, having a potential of from 25 to 118 volts, with the exception of that for heating air, the car heater operating at 400 to 500 volts, and the heating apparatus for building at 104 to 236 volts.

Having noted the salient features of the apparatus, a detailed description of some practical tests will be of interest.

A hot water reservoir constructed of copper, tinned on the inside, nickeled on the outside, and having a capacity of 23 pounds of water at 60 Fahrenheit, without jacketing, and having an electrically heated bottom forming an integral part of the vessel, had placed in it 16 pounds of water from the service tap, at a temperature of 57 Fahrenheit. This was raised to 128 Fahrenheit in 20 minutes, or an effect was produced of 1136 lb deg. Fah., with an expenditure of electrical energy amounting to .326 horse power hour, which, at the contract price for power when and where this test was made, of 5 cents per horse power hour costs $ 0163, and the lb. deg. Fah. costs $ 00001434.

The cost of boiling one gallon from 40 Fahrenheit does not exceed 2 cents, by actual test, at this rate for energy. Some 500 heat units are expended in heating the vessel, and in radiation, so that the actual cost of the heat unit is in round numbers one one-thousandth of 1 cent.

In the oven 10 pounds of beef have been roasted, 2 loaves of bread baked and 12 plates heated for serving, all in 90 minutes, "from the cold," with an expenditure of energy amounting to 1.5 horse power hour, or 1119 watt hours; this at 5 cents per horse power hour is 7½ cents; or at 10 cents per horse power hour is 15 cents. At the 5 cent rate this oven costs about 2⅓ cents per hour, the first expense of "heating up" being gradually eliminated with each hour of continued service. Chops are cooked for 1 cent, an oyster stew made for ½ cent, tea and coffee for 4-10 of a cent, all in sufficient quantities for the ordinary table, the energy rate being 5 cents per horse power hour.

Large electric cars are heated to 60 Fahrenheit, under all weather conditions, with an average consumption of energy of 1,000 watts per hour, in the climate of Boston. This should be very satisfactory, though no exact figures of expense can be given, as the cost of power on electric railways is not stated It is fair to assume that it costs not more than 40 cents per car day of 18 hours. When electric cars are heated they undoubtedly divert to themselves sufficient carriage patronage to pay for the heating.

The average well-built city house in a block requires an equipment for heating, on the basis of an expenditure of electrical energy of 1 horse power per 1,200 cubic feet of space, though this amount is by no means required to be used continuously, and is stated as a maximum. It is impossible to give any exact figures unless for a particular instance when all the conditions are precisely stated. Steam heating engineers with long experience and voluminous data are accustomed to calculate the individu l

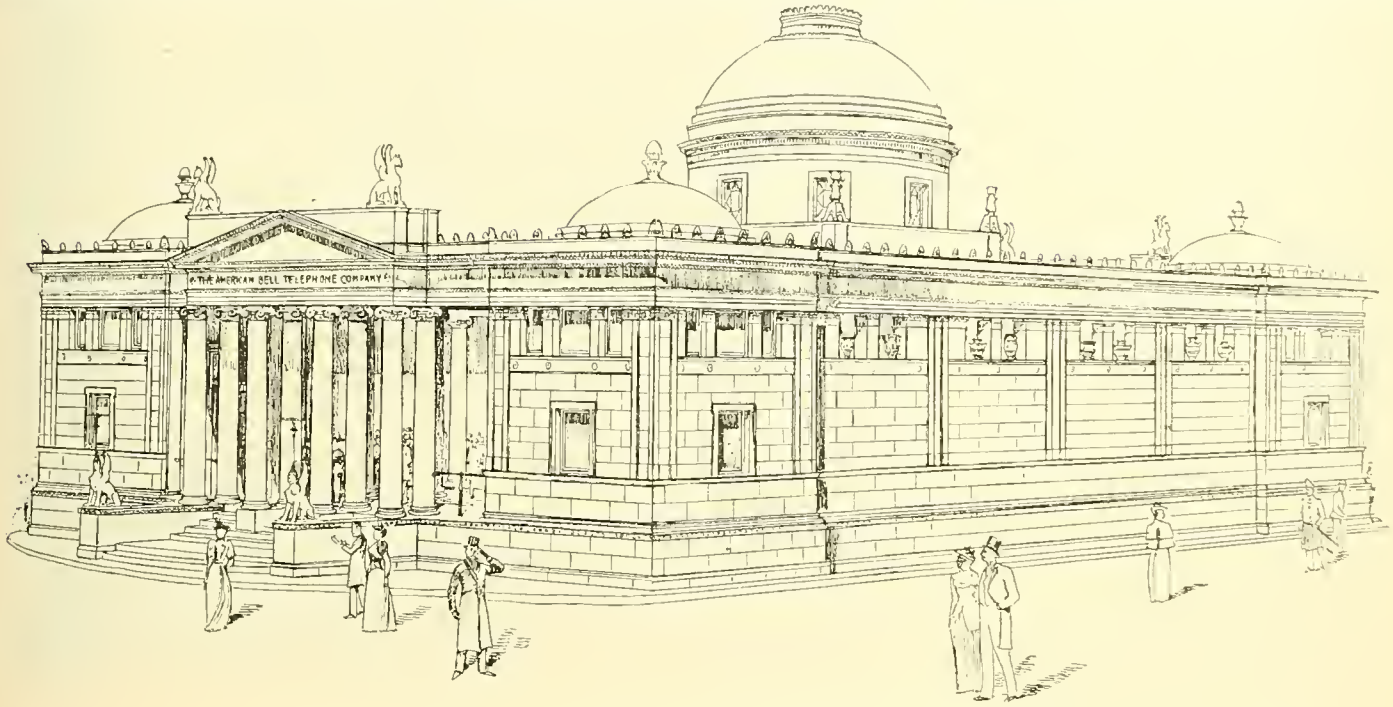

FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.—TELEPHONE PAVILION, ELECTRICITY BUILDING.

1. Read before the Chicago Electric club, May 15, 1893.

requirements, and only then will they guarantee results.

The ultimate large development of electric heating necessitates the production of vastly greater amounts of electrical energy than have heretofore been considered necessary; and it will be a growth, steady and sure, culminating, in less time than electric lighting has been before the public as a commercial entity, in a great industry, second only to the supplying of food.

It is now being adopted by many who are conversant with its advantages, who can at once replace the old contrivances with the new, and must very shortly be adopted by the many who, doing a part of the labor incidental to the household, seek to do it as easily, cleanly, and economically as possible, and by those who consider the welfare of dependants and that observance of economy which is both wise and honorable.

It was, in times past, faucet *vs.* pump; it is now switch *vs.* coalhod, and the triumph of the switch is unquestionably at hand, for the introduction of electric heating into houses, offices, hotels, hospitals, and theaters is being accomplished on a purely commercial basis.

Tyndall's estimates being accepted, that 6 per cent. or 780 heat units of the 13,000 in one pound of coal were utilized as a maximum, and assuming that 800 are now utilized, then 2,000 pounds of coal produces in useful effect 1,600,000 heat units.

One horse power hour of electricity produces 2,562 heat units, and upon this basis the following comparative table of the useful heat from coal and that from electricity has been calculated.

A horse power year is assumed to be 4,000 hours out of the 8,760 which the year contains.

EQUIVALENT USEFUL HEATING CAPACITY OF COAL AND ELECTRICITY.

ELECTRICITY.			COAL.
Per Watt-hour.	Per H. P. Hour.	Per H. P. Year.	Per 2000 lbs. delivered.
$.000013405	$0.001	$ 4.00	$ 0 624
	.002	8.00	1.248
	.003	12.00	1 872
	.004	16.00	2.496
.000067025	.005	20.00	3.12
.00008043	.006	24.00	3.745
.000093835	.007	28 00	4.368
.00010724	.008	32.00	4.992
.000120615	.009	36.00	5.61
.00013405	.01	40.00	6 24
.0002681	.02	80.00	12.48
.00040215	.03	120.00	18.72
.0005362	.04	160.00	24 96
.00067025	.05	200.00	31.20
.0008043	.06	240.00	37.44
.000938535	.07	280.00	
.00107240	.08	320.00	
.001206345	.09	360.00	
.00134005	.10	400.00	

In round numbers, electricity at $.015 per horse power hour or $60.00 per horse power year of 4,000 hours (which is eleven hours per diem on an average) is equivalent in practical useful heating effect to coal at $6.00 per ton, and the coal must be hard coal of best quality, burned with good ordinary care and discretion. This is on the basis of a contract for power as follows, viz, consumer of power agrees to pay $60.00 per horse power per year, using it whenever he chooses—at the time if he desires—perhaps 8,760 hours; but the average use of the householder under average circumstances, would be 4,000 hours only—or eleven hours per diem throughout the year, except in sections of the United States, south of the Mason and Dixon line, where it would average about 3,000 hours only.

It should be observed that electrical energy can never be adulterated; that exactly the amount used is paid for, if attention at is given to the measurement. It is easily possible to measure electricity with greater precison than any other commodity, and to calculate the expense of any work done to the thousandth of a mill, if desired.

The preceding estimate is for the heating of houses only; the cooking is on a different basis entirely, as electricity at 5 cents per horse power hour will compete directly with coal at $5.50 per ton of 2,000 pounds.

Mr. Greene's Libel Suit.

The following statement by the *Boston Herald* will prove interesting in view of the proceedings instituted by the General Electric company against B. E. Greene, publisher of *Electricity*, to which reference was made last week:

Attention has been called to a fact, which until now has escaped notice, that there was a fatal omission of the word "fifth" in C. A. Coffin's reply to a series of categorical questions sent to him by a director of the General Electric company, as published in the evening edition of this paper on May 11th. Mr. Coffin was made to say:

"I can answer categorically to each one of the questions 'no,' except to the first part of your inquiry, and to that I answer 'yes.'"

Now, this should have read "except to the first part of your fifth inquiry," etc., and it did so read in the morning edition of May 12th, for which edition proof was read from the original copy, which was reprint.

This matter is revived now to correct any misapprehension which may have arisen from the compositor's blunder and because a technical paper in New York, or its owner, has been indicted for libel in part, at least, for republishing on May 17th the correspondence between Mr. Coffin and a fellow-director as it appeared in this paper on the evening of May 11th. The *Herald* regrets that a typographical error, for which human frailty was alone responsible, should have temporarily perverted fact and led to unpleasant consequences to any of its readers.

An electric street railway is to be constructed from Mansfield, R. I., to connect with Foxboro and Wrentham.

The Electric Heater.[1]

By T. Ahearn.

The increasing interest manifested in electric heating apparatus during the past year throughout the United States and Canada is highly satisfactory and, without a full knowledge of what interesting application of heating devices may have been made in the United States, I will endeavor in this paper to outline what we have accomplished in Canada and more particularly in the city of Ottawa.

The ideas relating to the limited field of electric heating are fast disappearing, and the notion that an electric light or railway plant, unless operated by water power, cannot profitably introduce electric heat is but an instance of history repeating itself, as witness the introduction of the telephone, incandescent light, etc.

When friction is overcome, heat is produced, whether the friction be the resistance of any portion of an electric circuit or of a purely mechanical character, as, for example, the application of the ordinary car brake, the resultant equivalent in each case appears as heat, so that if one or five horse power of electrical energy be absorbed in an electric heater the full amount is converted into heat.

A mechanical example of this conservation of force may be demonstrated by rubbing the right hand on the coat sleeve of one's left arm—if the rubbing is brisk and continued an unpleasant heating of the hand will result, the force expended in the muscular effort of rubbing results in an exact equivalent of heating of the hand, and the coat sleeve rubbed. This result is practically analagous to the heat developed in the wire of an electric heater. The resistance (or friction) offered, as in the rubbing of the coat sleeve, results in developing an exact equivalent of heat.

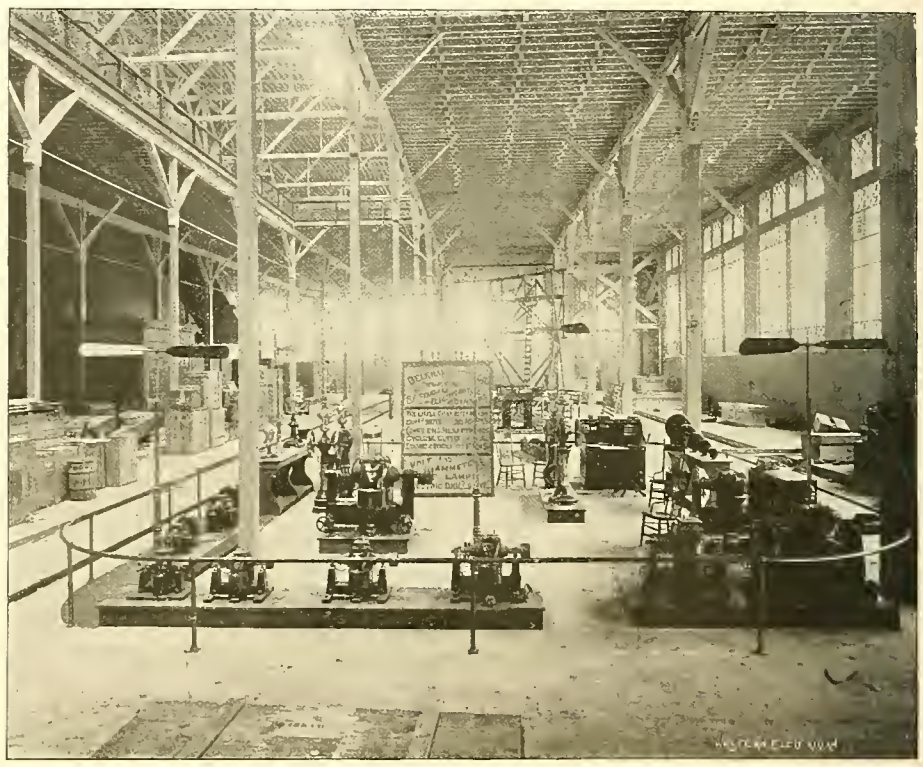

FIG. 6. ELECTRICITY AT THE WORLD'S FAIR.—BELKNAP MOTOR COMPANY'S EXHIBIT, ELECTRICITY BUILDING.

The operation of the electric heater may also be compared to that of an incandescent lamp in which, as is well known, good conductors of electricity are carried to the terminals of the lamp filament, which is purposely made a poor conductor, in order that the resistance offered by the filament and overcome by the current may produce a sufficiently high degree of heat to give the desired light. Although light alone is the object sought, it is but an accompaniment of the incandescence of the filament. In the electric heater, heat alone is desired, and heat alone is present.

The size and length of the lamp filament and the wire of the heater are both determined in very much the same manner, excepting that in the case of the heater, the calculation for the amount of wire does not subject the heating wire to such a degree of heat as in the case of the incandescent lamp. The size and length of wire employed in a serviceable electric heater should be such that the heat developed will not be sufficient to destroy it by oxidation or fusion. This is greatly assisted by the design and other conditions of manufacture, and in the case of my cylindrical 500 volt upright car stove the inlet of cooler air at the bottom and its rush through the heated cylinder result in a vigorous circulation of air through the space to be warmed, and this displacement of hot air by cooler air constantly relieves the heater wire within the stove.

Instead of making heaters on the plan of the rheostat, I have found that for marked results, and more particularly for the air draught, it is desirable to conserve the heat within the heater up to a certain degree, above which the construction of the heater should not permit the wire to reach.

I have also concluded that iron wire is most desirable, and among many of the points in its favor is that its resistance increases with the heat. The benefit of this quality is felt when the electromotive force is increased, as frequently happens for short intervals in nearly all classes of circuits.

By this method of construction and the use of good non-conductors of heat as insulation and packing, the heat developed in small water heaters and large water furnaces is directed to the copper water containing vessels around which the heating wire is wound; the heat is quickly transferred from the wire to the copper vessel which can never reach a very high degree of heat. The air draught in my other heater operates in very much the same manner as the presence of the water in the liquid heater.

It is an interesting fact that good conductors of heat are also good conductors of electricity, and the poor for one are also poor for the other. This conductive quality, which is common to both forms of force is very suggestive of a close relationship, which doubtless future investigation will determine. With the good conductors, such as copper, the current may be imagined as gliding freely through the atoms of the copper; while in the case of the comparatively poor conductor, iron, the atoms may be pictured to throw themselves, like barriers, across the track of the current, this friction, or as we term it, resistance, resulting in the development of heat. The mutual convertibility of the various natural forces is evinced from the combustion of coal in a power house, the dynamo converting the energy supplied by the coal into the convenient form of electricity, which is transmitted along wires to electric heaters placed at different points in the circuit, where we again have heat as at the starting point, the heater in turn giving up its heat to the surrounding air. It is evident thus that from electricity heat may be obtained; it is also true that from heat we can obtain electricity as in the ordinary thermo-electric pile—the application of heat to the junction of the dissimilar metals of the pile will be demonstrated by the movement of the needle of the galvanometer.

I will now proceed to a brief description of some of the electric heating installations which have been in successful operation during the past winter.

In July of last year I had erected in the car shop of our local electric railway a baker's oven eight feet square, which was built of brick in the usual way excepting that within the oven and set in the foundation were placed two of my 20 ampere, 50 volt cylindrical stoves, the interior of the oven being whitened and lighted with incandescent lamps, a small window looking into the oven and provided with three panes of plate glass separated from each other by air spaces being provided for the purpose of observing the process of baking and cooking. The oven was also equipped with a clock and pyrometer, which latter instrument recorded the degree of heat within the oven. The pyrometer indicating 400° Fahr., a neighboring baker tried a few pans of buns. The process of baking was watched with much interest, and from the puffing up of the dough to the pretty brown finish could be seen through the window of the oven, which, as before stated, is provided with incandescent lamps. A short time after, a full dinner of one of our leading hotels was cooked, including a 21 pound roast of beef, several turkeys, ducks and lamb. This electric dinner was served to the regular guests of the hotel, together with a distinguished company of invited guests. The cooking of the meats was pronounced perfect, and the time occupied in cooking was thirty minutes less than is usually required to do the same work in the hotel range.

It may be interesting to know that this oven has been in full blast since it was started, and the current has been applied constantly night and day without trouble of any

[1] Read before the Chicago Electric Club, May 22, 1893.

kind, and it is now used in drying out repaired electrical parts of railway equipment.

At the Central Canada Fair, held in Ottawa in September of last year, a baker's oven the same as described was erected in the main building, attended by a staff of bakers. The oven was provided on one side with a window, through which our delighted rurralists gazed in wonder. The oven proved the great card of the show, and the presence of a special policeman was required to keep the crowd moving. The baker started in selling a small bag of buns at five cents on the first day, but the law of demand justified him in increasing the price to twenty-five cents on the last day of the exhibition, when the supply was not sufficient, although fourteen pans were turned out every fourteen minutes. In the same building the Woman's Christian Temperance Union dining hall was made somewhat more attractive than in former years by the use of large electric water heaters, which supplied a dozen smaller heaters placed conveniently, and in which were made tea and coffee. The outfit was kept in continuous operation during the fair, and although hard pressed by the crowds present the supply was ample; no other means of heating water was employed. The success of this display will be best appreciated by the fact that the financial results were for the first time in many years of a satisfactory nature.

An ordinary hot water radiator connected by pipe with an electric furnace placed in a pit below the floor, lighted by incandescent lamps and covered with an iron grating flush with the floor, attracted the attention of householders. The absence of a chimney and other accessories of a hot water coal furnace, added to the fact that the closing

FIG 5. ELECTRICITY AT THE WORLD'S FAIR.—EXHIBIT OF THE E S GREELEY & CO., ELECTRICITY BUILDING.

of a switch only was necessary to obtain heat which might be continued indefinitely without dirt, dust or labor, was doubtless the main reasons for the innumerable inquiries made as to the cost of operation.

As no long continued test of this form of hot water house heating had ever been made, I concluded that only two installations of this description should be made during the winter just passed.

The first installation was made for the purpose of heating a gentleman's conservatory in Ottawa. The furnace was placed in the basement, the controlling switches on the floor above, and all connected with the 50 volt lighting circuit. The total amount of pipe employed in the conservatory was 300 feet, the current absorbed being equal to 3 horse power. The amount charged by the light company was based upon the cost of an equal amount of power from a motor circuit. The operation of this plant has been a great success, having worked continuously and absolutely without attention since October last, the user being so much pleased with its success that the question of heating the entire premises electrically is now under consideration.

The second installation of the hot water system was made in R. A. McCormick's drug store, Sparks street, Ottawa. The premises were piped throughout for hot water heating in November of last year, the electric furnace being placed in the basement. This 50 volt furnace was constructed in five independent heaters radially connected to a common supply pipe, each heater being independent of its neighbor, the five sections both mechanically and electrically being connected in multiple. Each of the sections was controlled by five 10 ampere switches which were placed in a row in the store above, so that for all conditions of the weather the heat could be regulated by turning off or on any of the five sections into which the furnace was divided. Another important consideration which suggested this design was that in the event of trouble with any one of the five sections comprising the complete furnace, it could be detached by closing the valves, and the particular section which might require examination could be removed without disturbing the other four-fifths. Despite the fact that the past winter was unusually severe in this usually cold climate, this outfit worked without a hitch and without attention of any kind, and provided at all times the heat desired.

For the usual Christmas display of the Chandiere Electric Light company, I designed an electric upright boiler, which operated a 1 horse power engine, both the engine and the boiler being placed upon a large table in the company's office. The boiler was provided with steam gauge, water glass, safety valve, etc. Being nickel plated throughout, it presented a very handsome appearance. The safety valve was set for 35 pounds pressure, which operated the engine. As heretofore steam engines have been employed in applying the power necessary to energize dynamos, the novelty of this outfit consisted in the fact that the electricity was developed by water power, which was converted into heat, making steam in the boiler, and which was then used in driving the steam engine.

The charge that is here made for current used in the numerous one gallon water heaters which have been largely introduced by the Chandiere Electric Light company is based upon the amount charged for the 16 candle power lamp, which is $8.00 per annum (the user paying for lamp renewals). Motor rates are charged for larger installations. These water heaters are used in barber shops, drug stores, bar rooms, etc., and absorb three times as much current as one 16 candle power lamp. The company collects fifty cents per week for the current supplied each heater, making $26 per annum as against $24 if the same current were used for lighting. The charge is considered small by the users and the service is very satisfactory.

The business done here during the past year in electric heating devices of various kinds has amounted to a very respectable sum and will here—as it should elsewhere—increase from year to year.

Last week an organization known as the Central Indiana Electric Railway company was perfected with a capital stock of $4,500,000. The purpose of the organization is to connect Indianapolis with Noblesville, Ind., and other towns with electric street car lines. The stockholders are Paul Pontus, Philadelphia; Illinois Electric Railway company, Chicago; J. T. Baker, Lewisburg, Pa.; N. D. Potious, Chicago; W. B. Keep, Chicago; G. A. P. Kiitz, Washington Heights; J. E. Crane, F M. S. Meten, C. H. W. Johnson, Chicago, and S. Harry Oliver, St. Louis.

It would appear that the city of Manchester, N. H., is suffering from the same species of municipal government in relation to its electric lighting that has disturbed other cities in the past few months. The city at present has a contract with an electric lighting company, which will not expire for eighteen months, but it was recently announced by the city government that a ten years' contract had been made with the Manchester Electric Light company for lighting the streets or the city. The publication of this notice created considerable astonishment and adverse criticism, as no bids had been received on the proposition. Soon after the contract was awarded the electric company of Manchester expressed its willingness to make a proposal to the city for doing the same lighting at a figure between $75 000 and $100,000 less than the contracted price to be paid the Manchester company. Now the taxpayers are demanding not only that the contract be revoked but that the city officials explain why such a contract was awarded eighteen months ahead of time and without receiving competitive bids.

Magnetic Curve Tracer.

At the recent conversazione of the Royal Society in London Prof. Ewing exhibited several magnetic curve tracers, one of which is illustrated in Figs. 1 and 2. This instrument shows the magnetic quality of iron, steel or other magnetic metal, by exhibiting the curve which connects the magnetization B with the magnetizing force H in any magnetizing process. The curve is exhibited upon a screen by

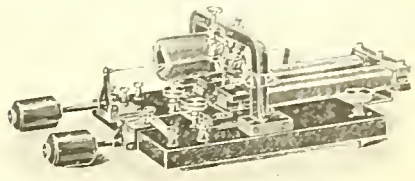

FIG. 1. MAGNETIC CURVE TRACER.

the spot of light reflected from a mirror, which receives two components of motion. The vertical component is proportional to the magnetization, and the horizontal component to the magnetizing force. Fig. 2 is a diagram showing the functions of the various parts. The mirror is pivoted upon a single needle point, which leaves it free to turn both ways, and it is connected by threads to the middle of two stretched wires, A A and B B, in such a manner that when either of the wires sags the mirror suffers a corresponding deflection. The threads are kept taut by light springs, the tension of which is adjustable. The wires are stretched in narrow slots, forming gaps in two magnetic circuits, D D and C. One of these circuits, D D, is made up of the iron or steel to be examined, along with suitable pole-pieces and yoke, and the current which passes through the magnetizing coils of this circuit passes also through the stretched wire, B B, in the gap of the other magnet. The other magnet is constantly magnetized by a steady current, and a steady current also flows through the stretched wire A A. Hence, when the magnetizing current of D D is altered, the wire B B sags out or in, and gives horizontal motion to the mirror proportional to the magnetizing force acting on D D. And when the magnetism of D D is altered, the wire A A sags up or down, giving vertical motions to the mirror proportional to the changes of magnetism.

The samples to be tested form the arms of D D. They may be solid rods, or rods built up of thin strips, or of wire. The rods supplied with the instrument are of soft sheet iron, built up of insulated strips, with a net cross section about 1 inch by ½ inch and about 18 inches long. In preparing other rods for comparison of magnetic quality, the same dimensions are to be chosen as those of the standard rods. Clamps are provided at the pole-pieces to allow the rods to be readily inserted and removed. The cuts are reproduced from the London *Engineer*.

At the same meeting several striking experiments were made by A. C. Swinton on the lines originated by Tesla. The filament of an ordinary 5 candle power 100 volt lamp was caused to incandesce with current conveyed through the human body; the filament then gave out a yellowish light. Sparks, evidencing a difference of potential of some thousands of volts, were produced between the two hands of the same operator. A luminous spiral was produced in an exhausted glass tube by molecular bombardment from a wire spiral wound outside the tube. Some effects produced by high frequency discharges passing through semi-conducting substances, and striking liquids were also exhibited.

Professor Marshall Ward, by the aid of the electric lan-

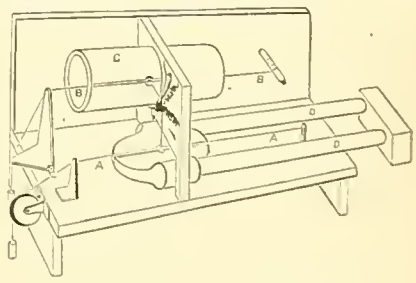

FIG. 2. MAGNETIC CURVE TRACER.

tern, exhibited on the screen some photomicrographs illustrating the action of solar and electric light on the spores of bacteria and fungi. The action of strong light is to kill them when the exposure is long enough, amounting in some cases to about two hours, and the blue rays are most powerful in producing the effect; the less refrangible waves of the spectrum have little influence in the matter.

The Waco, Tex., Electric Railway company will add two miles of track to its lines.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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VISITORS

To the World's Fair are requested to forward their addresses to the WESTERN ELECTRICIAN as early as possible or notify us immediately upon their arrival in Chicago.

REPORTS from Springfield, Ill., last week indicated that the Thiele lighting bill would not pass the lower house of the Legislature after all, in fact the outlook for having it reported by the committee on municipal corporations to which it had been referred was gradually diminishing. The bill was discussed in this committee last week and received little support. Speaker Crafts was appealed to for recognition to call the bill back to the House, but would give no promise. He said the bill should be amended to include incorporated towns, and by striking out the provision for the purchase of existing plants. A correspondent, commenting on this proposition says: "With that provision out, the bill would be of no possible use to Chicago, a fact that Mr. Crafts knows as well as he knows anything. The long and short of it seems to be that Mr. Crafts is as willing to see the bill killed as his committee is determined to kill it. McMurdy seems to be the only man on the committee who is fighting for the bill. Probably King and a few others would vote for it in the House but they don't seem to be wasting zeal on it in the committee. There is really no reason why the bill should receive favorable consideration, or, in fact, any consideration whatever. If the time of the members is of any value the bill should be summarily dismissed. The measure looks like a sand-bagging scheme, and no self-respecting member can be identified with it.

DESPITE the adverse criticism of experienced engineers projectors of street railway enterprises in which some other power than horses is required are looking to the storage battery for a solution of the problem. There is no doubt of the popularity of that system among the people, and progressive railway managers favor it on this account, but there are many who believe that the development of the battery can be accomplished much more satisfactorily in islolated lighting work. Prof. Forbes in his address at St. Louis said that this was the general impression in England, where considerable advancement had been made, and several American engineers expressed similar views. But storage battery men are not wanting who believe that with a fair trial accumulators can demonstrate their ability to compete with the overhead trolley system. It is gratifying to learn that such a test is about to be had in New York city shortly, and that an experimental station is now being equipped for that purpose. The work will be under the joint supervision of the battery company and the street railway corporation, and as the latter desires to utilize the battery, there is every reason to believe that it will be given a fair trial, and that the whole subject will be honestly investigated. It is to be hoped that figures will be presented showing the cost of operation, and that the experience thus gained will be placed at the disposal of the street railway mangers of the country. Heretofore it has been impossible to get reliable and explicit information showing fully the cost of installation and maintenance. Now, however, that the experiments are to be conducted by men favorable to the project, there should be no hesitation about keeping a complete record and giving it to the public.

TELEPHONIC journalism is a feature of life in Buda Pesth, and it is believed by the promoters of this novel scheme that it will prove popular with the people. It is proposed to establish a system covering the entire city, dividing it into eight districts, all of which are to be connected to the central office. At the telephone exchange a regular newspaper bureau is conducted, the news of the city being collected by a regular staff of reporters and foreign reports being received through the regular telegraphic service. All of this is condensed into the briefest possible statement for publication in the *Telephonic Gazette*. At 9 a. m. each day the "editor" assumes his post at the central station, and begins to tell the story of the day's news. After the first budget is sent out it is repeated in order that those who may have missed anything can be fully informed. At 10 o'clock the "second edition" is ready and at regular intervals throughout the day these oral editions of the *Telephonic Gazette* are issued. In the evening, lectures are reported, local entertainments are described for the benefit of the ladies, the latest attraction at the theaters are reviewed by the dramatic critic, and the young ladies are permitted to listen to a concert; "they can distinguish wonderfully well the touching pathos of the violoncello, the pearly staccatos of the violin, the sweet melodies of the flute, and the enchanting voice of the prima donna." The *Oriental Review* is authority for the statement that "by the aid of a single wire of the state telegraph line, our central station has been connected simultaneously with the telephone stations of Vienna, Gratz, Brunn, and Trieste; and in all those cities the voice of the *Gazette's* editor has been heard—clear, sonorous, and with every shade of intonation."

THE completion of the duplicate cable of the Central & South American Telegraph company last week marked an important achievement by American enterprise. The cable in question is 2 524 miles in length and was laid in ten months, a record heretofore unattained in cable operations. This company which, in conjunction with the Mexican Telegraph company and the Western Union Telegraph company, controls the cable business of the Spanish American countries, has a very comprehensive system. The cables begin at Galveston, Texas, running from that city to Tampico and Vera Cruz, in Mexico. This country is crossed at its narrowest point by land lines. From Salinas the cables reach Libertad in San Salvador and San Juan Del Sur in the lower part of Nicaragua. From the latter place one cable runs to Panama and touches lower down in the United States of Columbia; the other extends farther out into the Pacific; but the two lines meet on the coast of Ecuador. One line touches at Paytha in the upper part of Peru and both meet at Lima. The next point reached is Iquique, in Chile, and then the cables run down the coast to Valparaiso. Land lines extend directly across the continent from Valparaiso to Montevideo, and from that city the cable runs to Rio Janeiro. The companies have proved very profitable enterprises and have done much to attract capital to the countries in which they operate.

One result of the successful completion of the cable was to revive interest in the proposition to establish direct telegraphic communication between this country and Honolulu. The necessity of such a line was fully demonstrated at the time of the recent revolution in Hawaii. Even with only a remote possibility of annexation it is probable that a bill providing for an appropriation would now receive careful consideration by Congress. The Senate of the Fifty-first Congress passed a bill for that purpose but the House failed to concur. It did, however, authorize the making of a survey of the proposed route. This work has now been completed by the Thetis and the Albatross, and the results have been published by the Hydrographic Office. As a result it is shown that a cable can be laid to Hawaii having a length only a few hundred miles in excess of that of the original Atlantic wire from Valentia Bay to Heart's Content, and about equal to that of the line between Brazil and Africa. There are unquestionably high peaks and deep valleys in the Pacific, which make the route quite different from that of the Atlantic plateau, but the bottom is good, and it is favorable for preserving the cable. It is to be hoped that this much needed enterprise will be undertaken and carried to successful completion by American capital and American energy.

AFTER a month's delay the electricity building at the World's Fair now presents a practically finished appearance, although many beautifying touches here and there can still be added to advantage. The opening took place on June 1st, and although distinguished by no particular formality the affair proved eminently successful. One thing was proved beyond a doubt, and that is that the attractions of the electricity building form a center of great popular interest, and that the people like to see them at night. No better argument for opening the World's Fair on every evening could be advanced than the object lesson afforded by the way in which the people turned out to the evening illumination on Thursday night of last week. The wonders of electricity have a strange fascination for all, and the directors of the exposition can take no wiser or more popular step than to throw open the gates of the World's Fair at the time when this attractive feature can be seen at its best.

The various electrical features of the great exposition are now nearly all completed for public inspection, the two most conspicuous exceptions being the electric fountains and the 2,000 horse power directly connected engine and generator in the intramural power station. The extent and variety of the showing in this department is bewildering, and we can give no better advice to the visitor who is particularly interested in electrical matters than to get a general idea of the display from the World's Fair opening number of the WESTERN ELECTRICIAN, published May 6th, and then pick out such portions as he cares to examine in detail or lay out an itinerary for the whole.

It cannot be doubted that the electrical industry as a whole will be vastly beautified by the magnificent showing made at Jackson Park, where the well-nigh indispensable part played by electricity in modern American life is brought home to the visitor with great force at almost every turn. To mention one instance of the benefit that will accrue, it may be stated without fear of contradiction that the World's Fair will do more to popularize the electric launch among the well-to-do classes of the United States than ten years of ordinary commercial work. And so it will be, in greater or lesser degree, in all branches of electrical work. The World's Fair of 1893 will go down into history as the first international exhibition in which the commanding position of electricity, both in science and industry, was distinctively recognized. As such it should receive the loyal and hearty support of all members of the electrical fraternity.

But what of the future? What will be the next great step? Will it be the general application of electricity to existing long distance steam railways, the perfection of the storage battery for street railway service, the general adoption of electric heating, the production of incandescent light without conducting wires, or will it be possible to utilize the stored energy of coal in electricity without the costly interposition of boiler and steam engine? He would be a bold prophet who should attempt to foretell the limit, the *Ultima Thule*, of this line of progress. The subject is extremely interesting, but the perpetual query as to what the future has in store constitutes a question which Father Time alone can answer.

Light and Other High Frequency Phenomena.

By Nikola Tesla.

PART II.

These high frequency currents are obtained in a peculiar manner. The method employed was advanced by me about two years ago in an experimental lecture before the American Institute of Electrical Engineers. A number of ways, as practiced in the laboratory, of obtaining these currents either from continuous or low frequency alternating currents is diagramatically indicated in Fig. 1, which will be later described in detail. The general plan is to charge condensers from a direct or alternate current source, preferably of high tension, and to discharge them disruptively while observing well-known conditions necessary to maintain the oscillations of the current. In view of the general interest taken in high frequency currents and effects producible by them, it seems to me advisable to dwell at some length upon this method of conversion. In order to give you a clear idea of the action, I will suppose that a continuous current generator is employed, which is often very convenient. It is desirable that the generator should possess such high tension as to be able to break through a small air space. If this is not the case, then auxiliary means have to be resorted to, some of which will be indicated subsequently. When the condensers are charged to a certain potential, the air or insulating space gives way and a disruptive discharge occurs. There is then a sudden rush of current and generally a large portion of the accumulated electrical energy spends itself. The condensers are thereupon quickly charged and the same process is repeated in more or less rapid succession. To produce such sudden rushes of current it is necessary to observe certain conditions. If the rate at which the condensers are discharged is the same as that at which they are charged, then, clearly, in the assumed case the condensers do not come into play. If the rate of discharge be smaller than the rate of charging, then, again, the condensers cannot play an important part. But if, on the contrary, the rate of discharging is greater than that of charging, then a succession of rushes of current is obtained. It is evident that, if the rate at which the energy is being dissipated by the discharge is very much greater than the rate of supply to the condensers, the sudden rushes will be comparatively few, with long time intervals between. This always occurs when a condenser of considerable capacity is charged by means of a comparatively small machine. If the rates of supply and dissipation are not widely different, then the rushes of current will be in quicker succession, and this the more, the more nearly equal both the rates are, until natural limitations incident to each case and depending upon a number of causes are reached. Thus we are able to obtain from a continuous current generator as rapid a succession of discharges as we like. Of course, the higher the tension of the generator the smaller need be the capacity of the condensers, and for this reason, principally, it is of advantage to employ a generator of very high tension. Besides, such a generator permits the attaining of greater rates of vibration.

The rushes of current may be of the same direction under the conditions before assumed, but most generally there is an oscillation superimposed upon the fundamental vibration of the current. When the conditions are so determined that there is no oscillation, the current impulses are unidirectional, and thus a means is provided of transforming a continuous current of high tension into a direct current of lower tension, which I think may find employment in the arts.

This method of conversion is exceedingly interesting, and I was much impressed by its beauty when I first conceived it. It is ideal in certain respects. It involves the employment of no mechanical devices of any kind, and it allows of obtaining currents of any desired frequency from an ordinary circuit, direct or alternating. The frequency of the fundamental discharges depending on the relative rates of supply and dissipation can be readily varied within wide limits by simple adjustments of these quantities, and the frequency of the superimposed vibration by the determination of the capacity, self-induction and resistance of the circuit. The potential of the currents, again, may be raised as high as any insulation is capable of withstanding safely by combining capacity and self-induction or by induction in a secondary, which need have but comparatively few turns.

As the conditions are often such that the intermittance or oscillation does not readily establish itself, especially when a direct current source is employed, it is of advantage to associate an interrupter with the arc, and I have, sometime ago, indicated the use of an air blast or magnet, or other such device readily at hand. The magnet is employed with especial advantage in the conversion of direct currents, as it is then very effective. If the primary source is an alternate current generator, it is desirable, as I have stated on another occasion, that the frequency should be low, and and that the currents forming the arc be large, in order to render the magnet more effective.

A form of such discharger with a magnet which has been found convenient, and adopted after some trials, in the conversion of direct currents particularly, is illustrated in Fig. 2. *N S* are the pole pieces of a very strong magnet which is excited by a coil *c*. The pole pieces are slotted for adjustment and can be fastened in any position by screws s_1 s_1. The discharge rods d d_1, thinned down on the ends in order to allow a closer approach of the magnetic pole pieces, pass through the column of brass b b_1 and are fastened in position by screws s_2 s_2. Springs r r_1 and collars c c_1 are slipped on the rods, the latter serving to set the points of the rods at a certain suitable distance by means of screws s_3 s_3, and the former to draw the points apart. When it is desired to start the arc, one of the hard rubber handles h h_1 is tapped quickly with the hand, whereby the points of the rods are brought in contact but are instantly separated by the springs r r_1. Such an arrangement has been found to be often necessary, namely, in cases when the electromotive force was not large enough to cause the discharge to break through the gap, and also when it was desirable to avoid short circuiting of the generator by the metallic contact of the rods. The rapidity of the interruptions of the current with a magnet depends on the intensity of the magnetic field and on the potential difference at the ends of the arc. The interruptions are generally in such quick succession as to produce a musical sound. Years ago it was observed that when a powerful induction coil is discharged between the poles of a strong magnet the discharge produced a loud noise not unlike a small pistol shot. It was vaguely stated that the spark was intensified by the presence of the magnetic field. It is now clear that the discharge current, flowing for some time, was interrupted a great number of times by the magnet, thus producing the sound. The phenomenon is especially marked when the field circuit of a large magnet or dynamo is broken in a powerful magnetic field.

When the current through the gap is comparatively large, it is of advantage to slip on the points of the discharge rods pieces of very hard carbon and let the arc play between the carbon pieces. This preserves the rods and besides has the advantage of keeping the air space hotter, as the heat is not conducted away as quickly through the carbons, and the result is that a smaller electromotive force in the arc gap is required to maintain a succession of discharges.

Another form of discharger which may be employed with advantage in some cases is illustrated in Fig. 3. In this form the discharge rods d d_1 pass through perforations in a wooden box *B*, which is thickly coated with mica on the inside, as indicated by the heavy lines. The perforations are provided with mica tubes m m_1 of some thickness, which are preferably not in contact with the rods d d_1. The box has a cover *C*, which is a little larger and descends on the outside of the box. The spark gap is warmed by a small lamp *l* contained in a box. A plate *p* above the lamp allows the draught to pass only through the chimney *c* of the lamp, the air entering through holes *o o* in or near the bottom of the box and following the path indicated by the arrows. When the discharger is in operation the door of the box is closed so that the light of the arc is not visible outside. It is desirable to exclude the light as perfectly as possible, as it interferes with some experiments. This form of discharger is simple and very effective when properly manipulated. The air being warmed to a certain temperature has its insulating power impaired, it becomes dielectrically weak, as it were, and the consequence is that the arc can be established at much greater distance. The air should, of course, be sufficiently insulating to allow the discharge to pass through the gap disruptively. The arc formed under such conditions, when long, may be made extremely sensitive, and the weak draught through the lamp chimney *c* is quite sufficient to produce rapid interruptions. The adjustment is made by regulating the temperature and velocity of the draught. Instead of using a lamp it answers the purpose to provide for a draught of warm air in other ways. A very simple way which has been practiced is to inclose the arc in a long vertical tube with plates on the top and bottom for regulating the temperature and velocity of the air current. Some provision had to be made for deadening the sound.

The air may be rendered dielectrically weak, also, by rarefaction. Dischargers of this kind have likewise been used by me in connection with the magnet. A large tube is for this purpose provided with heavy electrodes of carbon or metal, between which the discharge is made to pass, the tube being placed in a powerful magnetic field. The exhaustion of the tube is carried to a point at which the discharge breaks through easily, but the pressure should be more than 75 millimeters, at which the ordinary thread discharge occurs. In another form of discharger, combining the features before mentioned, the discharge was made to pass between two adjustable magnetic pole pieces, the space between them being kept at an elevated temperature.

It should be remarked here that when such or interrupting devices of any kind are used and the currents are passed through the primary of a disruptive discharge coil, it is not, as a rule, of advantage to produce a number of interruptions of the current per second greater than the natural frequency of vibration of the dynamo supply circuit, which is ordinarily small. It should also be pointed out here that while the devices mentioned in connection with the disruptive discharges are advantageous under certain conditions, they may be sometimes a source of trouble, as they produce intermittences and other irregularities in the vibration which it would be very desirable to overcome.

There is, I regret to say, in this beautiful method of conversion a defect, which fortunately is not vital, and which I have been gradually overcoming. I will best call attention to this defect and indicate a fruitful line of work by comparing the electrical process with its mechanical analogue. The process may be illustrated in this manner. Imagine a tank with a wide opening at the bottom, which is kept closed by spring pressure, but so that it snaps off suddenly when the liquid in the tank has reached a certain height. Let the fluid be supplied to the tank by means of a pipe feeding at a certain rate. When the critical height of the liquid is reached, the spring gives way and the bottom of the tank drops out. Instantly the liquid falls through the wide opening, and the spring, reasserting itself, closes the bottom again. The tank is now filled, and after a certain time interval the same process is repeated. It is clear, that if the pipe feeds the fluid quicker than the bottom outlet is capable of letting it pass through, the bottom will remain off and the tank will still overflow. If the rates of supply are exactly equal, then the bottom lid will remain partially open and no vibration of the same and of the liquid column will generally occur, though it might, if started by some means. But if the inlet pipe does not feed the fluid fast enough for the outlet, then there will be always vibration. Again, in such case, each time the bottom flaps up or down, the spring and the liquid column, if the pliability of the spring and the inertia of the moving parts are properly chosen, will perform independent vibrations. In this analogue the fluid may be likened to electricity or electrical energy, the tank to the condenser, the spring to the dielectric and the pipe to the conductor through which electricity is supplied to the condenser. To make this analogy quite complete it is necessary to make the assumption that the bottom, each time it gives way, is knocked violently against a non-elastic stop, this impact involving some loss of energy, and that, besides, some dissipation of energy results, due to frictional losses. In the preceding analogue the liquid is supposed to be under a steady pressure. If the pressure of the fluid be assumed to vary rhythmically, this may be taken as corresponding to the case of an alternating current. The process is then not quite as simple to consider, but the action is the same in principle.

It is desirable, in order to maintain the vibration economically, to reduce the impact and frictional losses as much as possible. As regards the latter, which in the electrical analogue correspond to the losses, due to the resistance of the circuits, it is impossible to obviate them entirely, but they can be reduced to minimum by a proper selection of the dimensions of the circuits and by the employment of thin conductors in the form of strands. But the loss of energy caused by the first breaking through of the dielectric—which in the above example corresponds to the violent knock of the bottom against the inelastic stop—would be more important to overcome. At the moment of the breaking through the air space has a very high resistance, which is probably reduced to a very small value when the current has reached some strength, and the space is brought to a high temperature. It would materially diminish the loss of energy if the space were always kept at an extremely high temperature, but then there would be no disruptive break. By warming the space moderately by means of a lamp or otherwise, the economy as far as the arc is concerned is sensibly increased. But the magnet or other interrupting

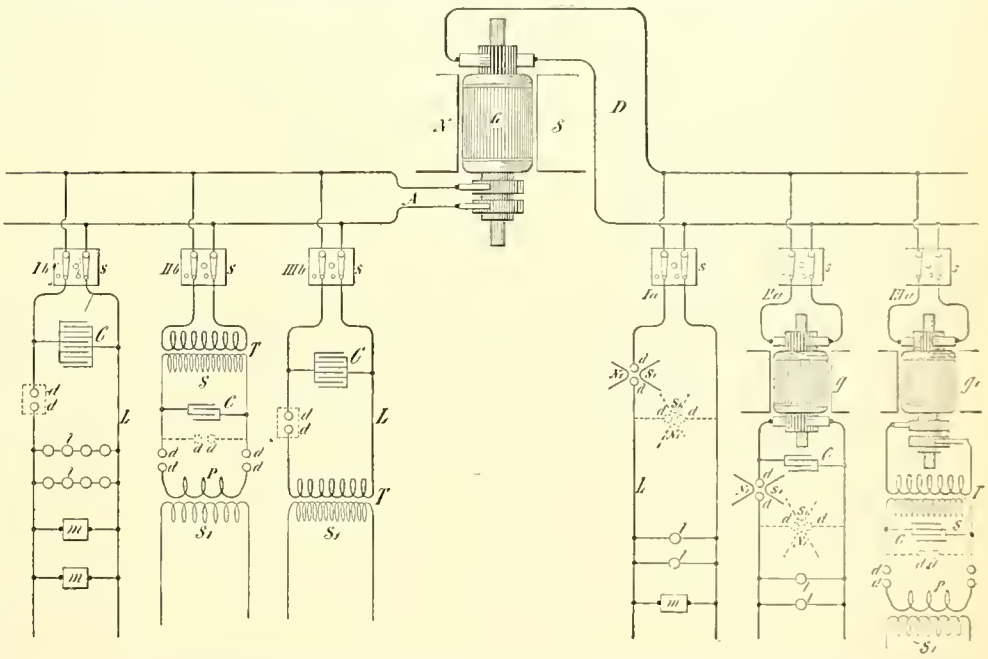


FIG 1. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—PLAN OF CONNECTIONS USED IN THE CONVERSION BY MEANS OF THE DISRUPTIVE ARC DISCHARGE.

device does not diminsh the loss in the arc. Likewise, a jet of air only facilitates the carrying off of the energy. Air, or a gas in general, behaves curiously in this respect. When two bodies, charged to a very high potential, discharge disruptively through an air space, any amount of energy may be carried off by the air. This energy is evidently dissipated by bodily carriers, in compact and collisional losses of the molecules. The exchange of the molecules in the space occurs with inconceivable rapidity. A powerful discharge taking place between two electrodes, they may remain entirely cool, and yet the loss in the air may represent any amount of energy. It is perfectly practicable, with very great potential differences in the gap, to dissipate several horse power in the arc of the discharge without even noticing a small increase in the temperature of the electrodes. All the frictional losses occur, then, practically in the air. If the exchange of the air molecules is prevented, as by enclosing the air hermetically, the gas inside of the vessel is brought quickly to a high temperature, even with a very small discharge. It is difficult to estimate how much of the energy is lost in sound waves, audible or not, in a powerful discharge. When the currents through the gap are large, the electrodes may become rapidly heated, but this is not a reliable measure of the energy wasted in the arc, as the loss through the gap itself may be comparatively small. The air or a gas in general is, at ordinary pressures at least, clearly not the best medium through which a disruptive discharge should occur. Air or other gas under great pressure is of course a much more suitable medium for the discharge gap. I have carried on long-continued experiments in this direction, unfortunately less practicable on account of the difficulties and expense in getting air under great pressure. But even if the medium in the discharge space is solid or liquid, still the same losses take place, though they are generally smaller, for just as soon as the arc is established, the solid or liquid is volatilized. Indeed, there is no body known which would not be disintegrated by the arc, and it is an open question among scientific men whether an arc discharge could occur at all in the air itself without the particles of the electrodes being torn off. When the current through the gap is very small and the arc very long, I believe that a relatively considerable amount of heat is taken up in the disintegration of the electrodes, which partially on this account may remain quite cold.

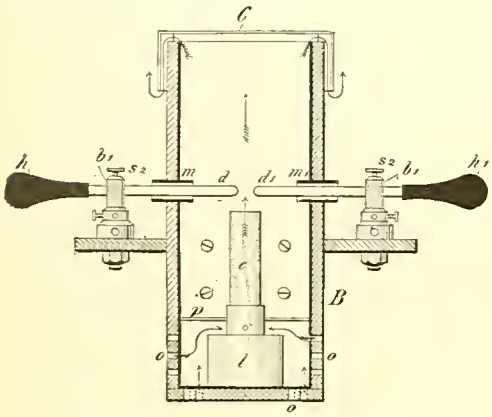
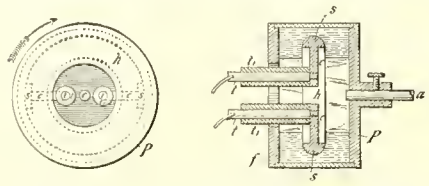


FIG. 3. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA. —DISCHARGES WITH HOT AIR DRAFT.

The ideal medium for a discharge gap should only crack, and the ideal electrode should be of some material which cannot be disintegrated. With small currents through the gap it is best to employ aluminum, but not when the currents are large. The disruptive break in the air, or more or less in any ordinary medium, is not of the nature of a crack, but it is rather comparable to the piercing of innumerable bullets through a mass offering great frictional resistance to the motion of the bullets, this involving considerable loss of energy. A medium which would merely crack when strained electrostatically—and this possibly might be the case with a perfect vacuum, that is, pure ether—would involve a very small loss in the gap, so small as to be entirely negligible, at least theoretically, because a crack may be produced by an infinitely small displacement. In exhausting an oblong bulb provided with two aluminum terminals with the greatest care I have succeeded in producing such a vacuum that the secondary discharge of a disruptive discharge coil would break through disruptively through the bulb in the form of fine spark streams. The curious point was that the discharge would completely ignore the terminals and start far behind the two aluminum plates which served as electrodes. This extraordinarily high vacuum could only be maintained for a very short while. To return to the ideal medium, think, for the sake of illustration, of a piece of glass or similar body clamped in a vise, and the latter tightened more and more. At a certain point a minute increase of the pressure will cause the glass to crack. The loss of energy involved in splitting the glass may be practically nothing, for though the force is great, the displacement need be but extremely small. Now imagine that the glass would possess the property of closing again perfectly the crack upon a minute diminution of the pressure. This is the way the dielectric in the discharge space should behave. But inasmuch as there would be always some loss in the gap the medium, which should be continuous, should exchange through the gap at a rapid rate. In the preceding example, the glass being perfectly closed, it would mean that the dielectric in the discharge space possesses a great insulating power; the glass being cracked, it would signify that the medium in the space is a good conductor. The dielectric should vary enormously in resistance by minute variations of the electromotive force across the discharge space. This condition is attained but in an extremely imperfect manner, by warming the air space to a certain critical temperature, dependent on the electromotive force across the gap or by otherwise impairing the insulating power of the air But as a matter of fact the air does never break down disruptively, if this term be rigorously interpreted, for before the sudden rush of the current occurs, there is always a weak current preceding it, which rises first gradually and then with comparative suddenness. That is the reason why the rate of change is very much greater when glass, for instance, is broken through, than when the break take place through an air space of equivalent dielectric strength. As a medium for the discharge space a solid or even a liquid would be preferable therefore. It is somewhat difficult to conceive of a solid body which will possess the property of closing instantly after it has been cracked. But a liquid, especially under great pressure, behaves practically like a solid, while it possesses the property of closing the crack. Hence it was thought that a liquid insulator might be more suitable as a dielectric than air. Following out this idea, a number of different forms of dischargers, in which a variety of such insulators, sometimes under great pressure were employed, have been experimented upon. It is thought sufficient to dwell in a few words upon one of the forms experimented upon. One of these dischargers is illustrated in Figs. 4*a* and 4*b*.



FIGS. 4*a* AND 4*b*. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—FORM OF DISCHARGER WITH LIQUID INTERRUPTER.

A hollow metal pulley *P* (Fig. 4*a*) was fastened upon an arbor *a*, which by suitable means was rotated at a considerable speed. In the inside of the pulley, but disconnected from the same, was supported a thin disc h_1 (which is shown thick for the sake of clearness), of hard rubber, in which there were embedded two metal segments *s s* with metallic extensions *e e*, into which were screwed conducting terminals *t t* covered with thick tubes of hard rubber *t t*. The rubber disc *h*, with its metallic segments *s s*, was finished in a lathe, and its entire surface highly polished so as to offer the smallest possible frictional resistance to the motion through a fluid. In the hollow of the pulley an insulating liquid, such as a thin oil, was poured so as to reach very nearly to the opening left in the flange *f*, which was screwed tightly on the front side of the pulley. The terminals *t t* were connected to the opposite coatings of a battery of condensers so that the discharge occured through the liquid. When the pulley was rotated the liquid was forced against the rim of the pulley and considerable fluid pressure resulted. In this simple way the discharge gap was filled with a medium which behaved practically like a solid, which possessed the quality of closing instantly upon the occurrence of the break, and which, moreover, was circulating through the gap at a rapid rate. Very powerful effects were produced by dischargers of this kind with liquid interrupters, of which a number of different forms were made. It was found that, as expected, a longer spark for a given length of wire was obtainable in this way than by using air as an interrupting device. Generally the speed, and therefore also the fluid pressure, was limited by reason of the fluid friction, in the form of discharger described, but the practically obtainable speed was more than sufficient to produce a number of breaks suitable for the circuits ordinarily used. In some instances the metal pulley *P* was provided with a few projections inwardly, and a definite number of breaks was then produced, which could be computed from the speed of rotation of the pulley. Experiments were also carried on with liquids of different insulating power with the view of reducing the loss in the arc. When an insulating liquid is moderately warmed the loss in the arc is diminished.

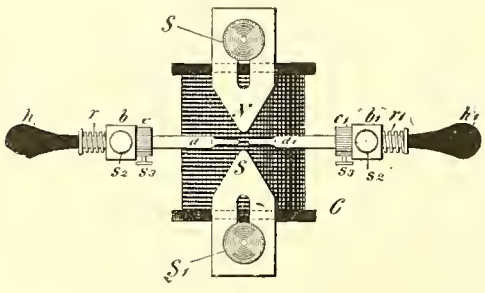


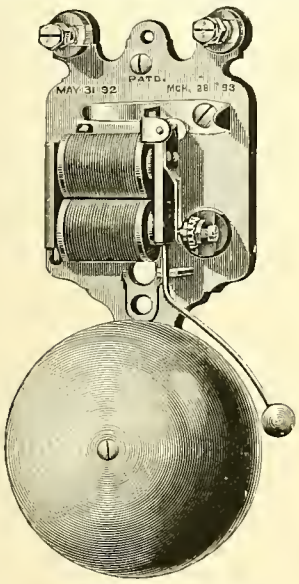
FIG. 2. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA. —FORM OF DISCHARGER WITH MAGNET USED IN THE DIRECT CURRENT CONVERSION.

A point of some importance was noted in experiments with various dischargers of this kind. It was found, for instance, that whereas the conditions maintained in these forms were favorable for the production of a great spark length, the currents so obtained were not best suited to the production of light effects. Experience undoubtedly has shown, that for such purposes a harmonic rise and fall of the potential is preferable. Be it that a solid is rendered incandescent or phosphorescent, or be it that energy is transmitted by condenser coating through the glass, it is quite certain that a harmonically rising and falling potential produces less destructive action, and that the vaccum is more permanently maintained. This would be easily explained if it were ascertained that the process going on in an exhausted vessel is of an electrolytic nature.

In the diagrammatical sketch, Fig. 1, which has been already referred to, the cases which are most likely to be met with in practice are illustrated. One has at his disposal either direct or alternating currents from a supply station. It is convenient for an experimenter in an isolated laboratory to employ a machine *G* such as illustrated, capable of giving both kinds of currents. In such case it is also preferable to use a machine with multiple circuits, as in many experiments it is useful and convenient to have at one's disposal currents of different phases. In the sketch *D* represents the direct and *A* the alternating circuit. In each of these three branch circuits are shown, all of which are provided with double lines switches *s s s s s s*. Consider first the direct current conversion; *Ia* represents the simplest case. If the electromotive force of the generator is sufficient to break through a small air space, at least when the latter is warmed or otherwise rendered poorly insulating, there is no difficulty in maintaining a vibration with fair economy by judicious adjustment of the capacity, self-induction and resistance of the circuit *L* containing the devices *l l m*. The magnet *N S* can be in this case advantageously combined with the air space. The discharger *d d* with the magnet may be placed either way as indicated by the full or by the dotted lines. The circuit *Ia* with the connections and devices is supposed to possess dimensions such as are suitable for the maintenance of a vibration. But usually the electromotive force on the circuit or branch *Ia* will be something like 100 volts or so, and in this case it is not sufficient to break through the gap. Many different means may be use to remedy this by raising the electromotive force across the gap. The simplest is probably to insert a large self-induction coil in series with the circuit *L*. When the arc is established, as by the discharger, illustrated in Fig. 2, the magnet blows the arc out the instant it is formed. Now the extra current of the break, being of high electromotive force, breaks through the gap, and a path of low resistance for the dynamo current being again provided, there is a sudden rush of the current from the dynamo upon the weakening or subsidence of the extra current. This process is repeated in rapid succession, and in this manner I have maintained oscillation with as low as 50 volts, or even less, across the gap. But conversion on this plan is not to be recommended on account of the too heavy currents through the gap and consequent heating of the electrodes; besides, the frequencies obtained in this way are low, owing to the high self-induction necessarily associated with the circuit. It is very desirable to have the electromotive force as high as possible, first, in order to increase the economy of the conversion, and, secondly, to obtain high frequencies. The difference of potential in this electric oscillation is, of course, the equivalent of the stretching force in the mechanical vibration of the spring. To obtain very rapid vibration in a circuit of some inertia a great stretching force or difference of potential is necessary. Incidentally, when the electromotive force is very great, the condenser which is usually employed in connection with the circuit need have but a small capacity, and many other advantages are gained. With a view of raising the electromotive force to a many times greater value than obtainable from ordinary distribution circuits, a rotating transformer *g* is used, as indicated in Fig. 2*a*, or else a separate high potential machine is driven by means of a motor operated from the generator *G*. The latter plan is in fact preferable, as changes are easier made. The connections from the high tension winding are quite similar to those in branch 1*a* with the exception that a condenser *c*, which should be adjustable, is connected to the high tension circuit. Usually, also, an adjustable self-induction coil in series with the circuit has been employed in these experiments. When the tension of the currents is very high the magnet ordinarily used in connection with the discharger is of comparatively small value, as it is quite easy to adjust the dimensions of the circuit so that oscillation is maintained. The employment of a steady electromotive force in the high frequency conversion affords some advantages over the employment of alternating electromotive force, as the adjustments are much simpler and the action can be easier controlled. But unfortunately one is limited by the obtainable potential difference. The windings also break down easily in consequence of the sparks which form between the sections of the armature or commutator when a vigorous oscillation takes place. Besides, these transformers are expensive to build. It has been found by experience that it is best to follow the plan illustrated in Fig. 3*a*. In this arrangement a rotating transformer *g* is employed to convert the low tension direct currents into low frequency alternating currents, preferably also of small tension. The tension of the currents is then raised in a stationary transformer *T*. The secondary *s* of this transformer is connected to an adjustable condenser *C*, which discharges through the gap or discharger *dd*, placed in either of the ways indicated, through the primary *P* of a disruptive discharge coil, the high frequency currents being obtained from the secondary *S* of this coil, as described on previous occasions. This will undoubtedly be found the cheapest and most convenient way of converting direct currents.

The three branches of the circuit *A* represent the usual cases met in practice when alternating currents are converted. In Fig. 1*b* a condenser *C*, generally of large capacity, is connected to the circuit *L*, containing the devices *ll, mm*. The devices *m m* are supposed to be of high self induction, so as to bring the frequency of the circuit more

or less to that of the dynamo. In this instance the discharger *d d* should best have a number of makes and breaks per second equal to twice the frequency of the dynamo. If not so, then it should have at least a number equal to a multiple or even fraction of the dynamo frequency. It should be observed, referring to *1b*, that the the conversion to a high potential is also effected when the discharger *dd*, which is shown in the sketch, is omitted. But the effects which are produced by currents which rise instantly to high values, as in a disruptive discharge, are entirely different from those produced by dynamo currents which rise and fall harmonically. So, for instance, there might be in a given case a number of makes and breaks at *d d* equal to just twice the frequency of the dynamo, or in other words there may be the same number of fundamental oscillations as would be produced without the discharge gap, and there might even not be any quicker superimposed vibration; yet the differences of potential at the various points of the circuit, the impedence and other phenomena dependent upon the rate of change, will bear no similarity in the two cases. Thus, when working with currents discharging disruptively the element chiefly to be considered is not the frequency, as a student might be apt to believe, but the rate of change per unit of time. With low frequencies in a certain measure the same effects may be obtained as with high frequencies, provided the rate of change is sufficiently great. So if a low frequency current is raised to a potential of say 75,000 volts and the high tension current passed through a series of high resistance lamp filaments, the importance of the rarefied gas surrounding the filament is clearly noted, as will be seen later, or, if a low frequency current of several thousand amperes,is passed through a metal bar, striking phenomena of impedence are observed, just as with currents of high frequencies. But it is, of course, evident that with low frequency currents it is impossible to obtain such rates of change per unit of time as with high frequencies, hence the effects produced by the latter are much more prominent. It was deemed advisable to make the preceding remarks, inasmuch as many more recently described effects have been unwittingly identified with high frequencies. Frequency alone in reality does not mean anything, except when an undisturbed harmonic oscillation is considered.



HUEBEL & MANGER BELL.

In the branch *3b* a similar disposition as in *1b* is illustrated, with the difference that the currents discharging through the gap *dd* are used to induce currents in the secondary *S* of a transformer *T*. In such case the secondary should be provided with an adjustable condenser for the purpose of tuning it to the primary.

Fig. *2b* illustrates a plan of alternate current high frequency conversion, which is most frequently used and which is found to be most convenient. This plan has been dwelt upon in detail on previous occasions and need not be described here.

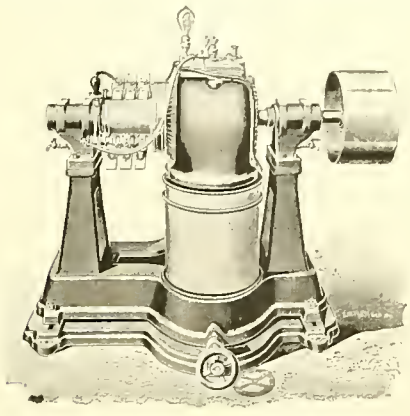
Some of these results were obtained by the use of a high frequency alteroator. A description of such machines will be found in my original paper before the American Institute of Electrical Engineers and in periodicals of that period.

Several extensive systems of electric railway are in a fair way to be built at once in the South. A number of Philadelphia capitalists have become interested in the line proposed between Dallas and Fort Worth, Tex., a distance of twenty-three miles. The Belt Electric company of Lexington, Ky., is considering the construction of an electric line from Lexington to Paris, a distance of eighteen miles. The estimated cost is $100,000, far less than the amount needed to build a steam power road. In Maryland, New York and Maryland capitalists have organized to build a road from Frederick to Middletown, Md., a distance of eight miles, with a possible extension along the Middletown valley. Surveys for the line have been made. In addition to the electric street railways in Washington, D. C., and its suburbs, surveys have been made for a line between Washington and Sandy Spring, Md., seventeen miles. Engineer H. B. Looker, who has located the route, says that it is intended to form one section of the proposed electric line between Washington and Baltimore via Ellicott City, Md.

New La Roche Direct Current Dynamo.

The cut herewith represents the new type of direct current dynamo built by the La Roche Electric Works of Philadelphia. This has been one of the most successful machines that has ever been turned out of the establishment, and for which the company has received a number of duplicate orders.

The machine is of the motor type, with Gramme ring armature of the latest improved construction, thereby reducing the speed very materially. It has all modern improvements, with all parts interchangeable and made to gauge. The machine is compound wound, and has been designed by F. A. La Roche. It has self oiling bearings and automatic oil-overflow. The brush holders are of a new design, and so made that any degree of tension can be secured, and so arranged that a free movement of the brushes around the commutator is allowed.



NEW LA ROCHE DIRECT CURRENT DYNAMO.

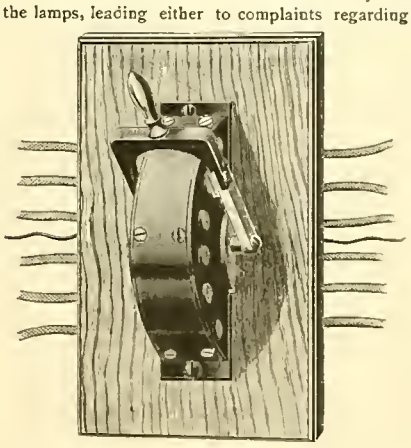
The commutator is made of specially hardened copper, well insulated with mica. It will be noticed that the winding of the machine is peculiar, as any of the coils, either series or shunt, can be removed and new ones put in place without interfering with any other part of the machine. An extra heavy steel shaft is used, thereby allowing no vibration and permitting the armature to run very close to the pole pieces, consequently increasing the efficiency of the machine.

At a test of one of these machines it was shown that there was a variation of only 1 3 10 volts between no load and full load.

Within the last three months the La Roche company has installed fifteen of these machines in Philadelphia and vicinity, and they are spoken of in the highest terms. The company is now making arrangements for an increase in its manufacturing facilities.

Cutter's Voltmeter Switch.

The average incandescent station has quite a number of separate circuits running from it, and in order to maintain the proper voltage on each of these, it has been the custom to have a voltmeter for each circuit. As first-class instruments are rather expensive the cheaper and more crude forms have almost always been used for this purpose. Of course, inaccurate voltmeters mean unsatisfactory service at the lamps, leading either to complaints regarding the light furnished or to a very short life of the lamps themselves. Any device that would allow a single and accurate voltmeter to be used with eight or ten circuits would do away with the faulty instruments and insure more satisfactory results.



CUTTER'S VOLTMETER SWITCH.

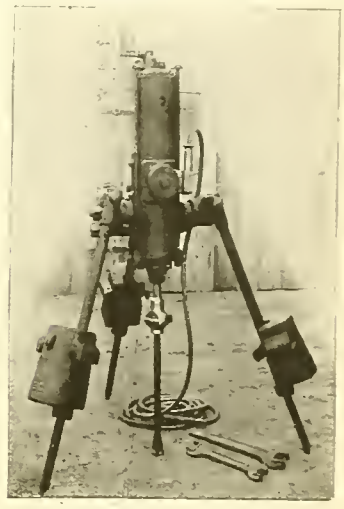
George Cutter of Chicago has perfected a special switch for this purpose, and practice has shown it to be well suited to the work. The size shown in the cut is used for connecting one voltmeter with any one of six circuits, while larger sizes can be used with as many as sixteen circuits. This voltmeter switch is nicely finished, so as to look well on any switchboard, and will no doubt create a large demand.

It is placed on the market by George Cutter, dealer in electrical specialties, 329 Rookery, Chicago.

Electric Percussion-Drill.

The electric percussion drill, since it was first put into practical operation, has undergone many changes, and today it can compete successfully either with the steam or compressed air drill. The manipulation of the drill, an illustration of which is presented in the accompanying cut, is in every respect as simple as that of the steam or air drill, stopping and starting being accomplished by merely throwing a handle to the right or to the left, making or breaking the contact between the cable and the terminals of the coils. Not the slightest difficulty is experienced in lubricating the wearing parts or in handling the drill. The generator which supplies the power is of the bipolar type, running at normal speed, and is provided with a device for directing the current alternately into the upper and lower coils of the drills. The difference of potential at the fixed brushes of the generator is 240 to 250 volts. The generator is belted to a 9 by 12 inch straight line engine, supplied with steam at 90 pounds pressure from a horizontal tubular boiler.

Three of these drills were recently installed by the General Electric company at the lime stone quarries of the Solvay Process company of Syracuse, N. Y. The plant has aroused wide spread interest among quarry operators, by whom it has been extensively inspected.



ELECTRIC PERCUSSION DRILL.

The Huebel & Manger Bell.

In the accompanying illustration is shown an electric bell recently devised by Huebel & Manger, of 286 Graham street, Brooklyn, N. Y., which contains a number of improvements over bells of this kind, which makes it quite worthy of mention and to merit the consideration of those interested in this line of electrical goods. There are two springs, as usual, one for the electrical contact and the other for adjustment. These are secured to the armature by the same rivets, and the end of the contact spring is rolled to form an eye which pivots on the mounting above which the cores of the magnets are riveted to the usual raised support at right angles to the base; the polar end of the cores has a flange which holds the magnet spools in place, and under one of the flanges is secured the pivotal mounting. There are grooves on the base to allow wires to be brought to binding posts. The end of the adjusting spring bears against a movable adjustable piece pivoted, and which is movable without loosening a screw, thus making easy adjustments. The binding posts and contact post are immovable. Contact points of platinum are riveted in spring and screw. Another improvement is a square washer in a rectangular depression under the binding post, thus enabling the termical wires to be secured without danger of being twisted off, which often happens when circular washers are used. The bell when finished is superior in every respect, and has already become quite widely known in the electrical trade.

It is reported that a line is being surveyed between Sausalito and San Rafael, Cal., for an electric road to be constructed by a citizen of San Francisco.

English View of the Incandescent Lamp Situation.

Those of our readers who have followed the events recorded in our past issues on electrical affairs in America will be aware that further lamp cases, instituted by the General Electric company were pending, says the London *Electrical Review*. The first of these since the one heard by Judge Colt at Boston came on for hearing on April 11th, and it was against the Columbia Incandescent Lamp company, a comparatively insignificant concern carrying on lamp manufacture at St. Louis. Public interest in the Goebel defense, which it was understood was again to be used, had begun to flag, and the case in question, after having been postponed more than once, attracted but little attention. The world is now startled by the news that the preliminary injunction demanded by the General company has been refused. It must be borne in mind that the opinion just delivered is merely a preliminary one which is based on the evidence of a number of affidavits and exhibits, and it therefore forms no certain criterion of the ultimate decision that may be arrived at, or of the effect it may have on the electric lighting industry generally. The ultimate conclusion can only be settled by a regular trial, which, unfortunately, will take a long time to prepare, owing to the numerous witnesses who will have to appear, and it is a question whether the Edison patent will not have expired before the case is finally disposed of. The decision just delivered does not even temporarily throw the market open to any material extent, since only the Columbia company and a few other undertakings, who have not yet been legally restrained, can continue to manufacture lamps. Those factories which have already been closed cannot, we understand, recommence work until the several injunctions laid on them have been removed, a proceeding which can only be effected by bringing the matter into court again in the various circuits on the ground of new evidence; and it is impossible to say whether Judge Colt and others would regard such evidence in the same manner that Judge Hallett has.

These circumstances, however, do not prevent the decision from being one of great moment, and the succeeding moves will be watched with intense interest all over the world.

We give a synopsis of the case elsewhere in this issue. It will be seen that the defense was argued in a most able manner by Mr. Kenyon, but, as a matter of fact, the case hung entirely on the Goebel story, the truth of which is, to our mind, still far from being conclusively proved. Several additional affidavits, 150 or more in all, and some fresh exhibits, were put in, but none of them had the uncontrovertible evidence that would have been contained for instance, by newspaper descriptions, illustrations or other documents. It is clear that there is falsehood on the one side or other, but without the assistance of searching cross examination it is difficult to ascertain on which side it exists. The testimony supporting the Goebel story is, it is true, exceedingly voluminous and consistent, while the attack on it by the plaintiffs, we admit, is very feeble. The story thus receives much indirect strength, but volumes of written evidence of this description is not necessarily actual proof in a case where perjury seems perfectly evident.

One weak point that strikes us in Mr. Kenyon's summing up is the explanation given for the Goebel matter not having been brought up in prior suits. The early knowledge of the matter is admitted by both defendants and plaintiffs. In the Boston trial, the reason given by Mr. Curtis for its non-use was that he did not sufficiently understand the extent to which Goebel had carried his experiments, and that had he known that evidence to the extent produced was forthcoming, it certainly would have been used; whilst on the other side the reason assigned was that Goebel was unreliable and had no old lamps to produce. The new explanation is that each side sought to hide the naked truth through self-interest. The Sawyer-Man company hoped to have its patents sustained, and the Edison company hoped to have its own triumphant, and thus it was to the interest of neither party to disclose the poor and unknown claimant to the incandescent lamp, and so let real equity reign. If interested motives are recognized as rational and sufficient reasons for hiding assured historical facts, what wonder that the affidavits presented on either side differ in their testimony in the manner they do; and on this ground what is there to prevent the whole Goebel story from being a fabrication?

Assuming the story to be true, there is no question that the defendant company is entitled to its victory. Judge Colt shirked the question in regard to the lamp exhibits Nos. 1, 2 and 3 by expressing the opinion that the devices were not practicable incandescent lamps, and that there was, therefore, no need to decide on their genuineness. He accordingly decided the case almost solely on the lamp exhibit, No. 4, which he held was not a genuine production. The question of the filamentary character of the carbon, which is manifestly used in the exhibits Nos. 1, 2 and 3, was not clearly put before the judge as being the crucial point at issue. But in the present case the principal argument was the one of the attenuated carbon of high resistance, being the only point of novelty in Edison's patent; and that if it could be shown that it had been used before as an illuminant, then the patent must necessarily be null and void from want of novelty.

The decision is naturally viewed in various aspects by the several persons who are interested in the lamp industry. While all of those who side against the policy of the General company are naturally more or less pleased at the result, they are by no means all convinced of the truth of the Goebel story—especially those who, like Ward Leonard, find it difficult to believe in modern miracles. On the other hand, one of the counsel representing the General Electric company is said to have expressed his views to the effect that while Judge Hallett's decision was unquestionably a reverse, it was regarded as only a temporary one. Similar injunctions had been refused to the Bell Telephone interests, but they had been without final effect; steps to bring the Columbia case to a final hearing will be vigorously proceeded with.

The statement made at the conclusion of the defendant's summing up to the effect that the plaintiffs have now a case before the Supreme Court, with the object of extending the life of Edison's patent until 1897, will come as a piece of interesting news to many persons in Europe.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 3.—It will evidently take a long time for the trolley car to commend itself to the confidence of the average lay press. There have recently been some accidents on the Brooklyn electric roads, and the outcry against the trolley system, which had lulled for a while, has been raised again with renewed vigor. One of the leading dailies, an organ which is usually noted for its clear and intelligent view of things electrical, says: "But experience has shown that this peculiar device known as the trolley car, by reason of the powerful current of electricity used in operating it and the frequent difficulty of controlling its movements, is constantly liable to kill people. Its victims far outnumber those of capital punishment and are more numerous than those of the ordinary murderer in the same community. Exact statistics might show the trolley to be a rival of any epidemic disease by which we are wont to be visited. Is the killing of people by the deadly trolley any less manslaughter because the operating of that device is authorized by law or by the Railroad Commission?"

Another question to which the dailies have during the last few days given much attention is the measurement of current supplied to central station customers. For some time the customers of the Edison Illuminating company are said to have been complaining of excessive charges for current, that the meters used by the company are inaccurate, and that the charge for service is made by guesswork. The head of the firm who was dissatisfied with his bill suggests that provision be made by law for the settlement of differences arising from such fallible sources of a record as electric meters. His remedy is the appointment of state inspector to whom all disputes as to the consumption of electricity could be referred. The business of the electric companies is now so enormous that disputes must necessarily arise from time to time. It is contended that consumers should have some tribunal to which they can appeal in case of unreasonable or exorbitant charges and that until such a tribunal is established there will be no end to the disputes and vexatious lawsuits resulting from differences of opinion and defective meters in the transaction of the rapidly increasing business of the supply of electricity. Another correspondent maintains that this is unnecessary, for the meters supplied by the best houses to-day are thoroughly to be trusted. As an illustration he states that not long ago a company operating a large factory in this city found fault with its bill. It was said that the meter registered falsely. Another meter of a different type was put in, but the old one was also retained. After a month had elapsed a comparison was made, and one meter showed that $77.71 worth of electricity had been used, while the other, when computed, showed $77.87. It is believed that the complaints against the company in question are without reasonable foundation.

Capt. Griffin has taken the *Evening Post* severely to task for its statement concerning the General Electric company, that "the officers admit that a few weeks ago the company's financial situation was precarious," and for the further statement that the cash of the company on hand "outside of proceeds of these sales is $1,500,000, about one-half the amount reported as cash by its treasurer two weeks ago." Capt. Griffin says, with regard to the latter, that the General Electric company is not a banking institution and does not accumulate several millions of cash for the sole purpose of holding it indefinitely, but rather for the purpose of using it in its business and to discharge its proper business obligations. He continues: "I wish to say to you briefly that the officers and directors of this company, recognizing a few weeks ago that a determined attack was being made (apparently for speculative purposes) on the credit of this company, felt it incumbent upon them to consider whether such attacks, if persisted in, could by any possibility injure the company itself. It seemed to them that the wisest course was to take no risks in this respect, and they carried out this conclusion by converting into cash certain stocks, out of those which accrue to the company in the ordinary course of business, as a consideration for license rights granted to local companies. In this very simple way the purpose above indicated has been accomplished." A prompt retraction is then demanded, and the *Evening Post*, understanding "that the officers disavow the interview" on which its statement was based, withdraws it, and furthermore expresses its regret for having given currency to the statement "that the company's position was at one time precarious."

"A bona fide holder of 500 shares of the common stock of the General Electric Company" has written to a morning paper in reference to points connected with the recent sale by the company of about $2,000,000 of the stock of the New York Edison and the Boston Illuminating companies. He is evidently possessing his soul in patience through the stormy times on which the company's stock has lately fallen, for he says: "I am not in the market nor engaged in any 'bull' movement, but I know timid investors who have been frightened at a great loss out of their holdings. I myself have not sold a share, and shall not, unless unforeseen circumstances should oblige me to. I have been assured both yesterday and to-day (May 26th and 27th), by officers of the company that the dividend payable August 1st, is to be at the usual rate of 8 per cent."

C. W. Wetmore, the new president of the North American company, vice Henry Villard, resigned, has been practically the managing director of the company during the last two years, and has, according to those familiar with the affairs of the corporation, done a great deal toward repairing the damage the company sustained during the Baring panic. It is understood that the representation of Northern Pacific interests in its board will from this time on be reduced. Mr. Villard and one other Northern Pacific director, whose terms of office expire this year, will not be candidates for re-election. Their places will probably be filled by a representative stockholder, and by some one identified with the General Electric company, with which the North American company sustains close relations.

The indignation meeting which was to have been held on Monday evening at Madison Hall, for the purpose of protesting against the action of the Rapid Transit Commission, was postponed to Thursday in consequence of the somewhat tardy discovery that the hall was previously engaged. On Thursday evening, strange to say, it was found that the same mistake had been made again. A third adjournment was made to last evening, but the fliers which were printed announcing the date were not even distributed, and the attendance was so slim that the meeting was postponed indefinitely.

On account of the continued illness of Commissioner Spencer and the absence of Commissioner Inman from the city, the meeting of the Rapid Transit commissioners set for yesterday afternoon was postponed until next Wednesday at Commissioner Steinway's residence. During Mr. Steinway's illness the commission has been in the habit of meeting at his house, and many complaints have been made by persons interested in rapid transit that at these meetings reporters alone were able to gain admission. In connection with this a good story is told of Lawson N. Fuller, otherwise known as the "Sitting Bull of Washington Heights." Mr. Fuller takes great interest in rapid transit matters, and he presented himself at Mr. Steinway's residence at one of the meetings only to be told that none but reporters were admitted. Mr. Fuller accepted the situation, and learning the date of the next meeting, went to one of the newspaper offices, secured an assignment and reporter's badge, and again presented himself armed with credentials and was admitted to the meetings of the commission. It is said that the commissioners are anxious to have the work go on, and will probably have plans ready next Wednesday, so that all that will be necessary will be to make a choice between the two or three offered, and fix the date for the sale of its privileges. This is understood to mean that at the first meeting the commission will be in a position to do something definite and conclusive. It appears probable that soon after the meeting a sale will occur. It has been suggested that a proviso be enacted that will prevent the Manhattan people from "capturing" the new franchise either at the time of the bidding therefor or later. Both the *Herald* and the *Commercial Advertiser* assert squarely that the attitude of the Manhattan company justifies the city in declaring its charter forfeited, and advises that step in the public interest.

W. F. O.

Denver, Colo.

DENVER, COLO., June 3.—The tramway company recently changed its Broadway cable to an electric line. A similar change is expected to follow soon on the Colfax cable line. The Broadway line now gives all night service.

E. M. Burgess and Robert D. Hall of the Colorado Telephone company announce that the company will extend its line this summer from Leadville to Aspen, a dis-

tance of about 55 miles. The cost will be from $35,000 to $40,000.

Mayor Van Horn, it is said, intends to insist on a reduction in electric lighting charges. He believes that $10 a month is enough for arc lights on all night schedule. Heretofore, the city has been paying $12.50 a month.

The Park railway was recently absorbed by the tramway company, and the motive power changed from steam to electricity. The line is two and a half miles long, and connects with the Colfax cable at the loop running along the south and east sides of City park, to the northeast corner of the park; thence east on Alhambra avenue through Park Hill and More's Park Heights.

The Light & Power company, limited, has filed articles of incorporation. The incorporators are Ensign S. Wright, John M. S. Egan, Robert O. Old, Fred P. Dewey, P. L. Roberts, Fred R. Pneuman, and Casper S. Desch. The purpose of the company is to supply Clear Creek county, and particularly the towns of Georgetown and Silver Plume with electric and gas light, power and heat. The principal office of the company will be at Georgetown.

The Arapahoe Railway company has made a contract with a Chicago company for the construction of its new line. The line starts at Du Bois and Alameda avennes, a mile and a half east of Fairmount cemetery; thence runs along Alameda avenue to Hyde Park, up Hyde Park to Seventh avenue, west to Wisconsin avenue, and along Twelfth avenue to Colorado avenue, where it will connect with the tramway.

E. C. D.

PERSONAL.

Prof. Elihu Thomson and family are in Chicago, attending the World's Fair.

H. C. Thompson, representing the Electric Gas Lighting company, Boston, Mass., spent a few days in Chicago last week.

Charles Blizard, secretary of the Franklin Electric company of New York, was one of last week's visitors at the World's Fair.

C. E. L. Brown, of the Oerlikon Works, Switzerland, paid a flying visit to Chicago last week. Mr. Brown visited Jackson Park and expressed great admiration of the World's Fair.

NEW INCORPORATIONS.

Mason Electric company, New York, N. Y.; capital stock $25,000; to manufacture and sell electrical goods.

Hartman Manufacturing company, New York, N. Y.; capital stock, $25,000; to manufacture and sell gas and electric fixtures.

Virginia Traction company, Alexandria, Va.; capital stock, $100,000; to construct improvements and contract for real estate.

Cooperstown Gas & Electric company, Cooperstown, N. Y.; capital stock, $25,000; to manufacture and use gas and electricity.

Water, Light & Power company, Hot Springs, S. Dak.; capital stock, $100,000; to furnish light, heat, power and water; W. H. Train, Hot Springs, S. Dak.

Ida Grove Electric company, Ida Grove, Ia.; capital stock $15,000; to establish and maintain an electric plant for power and light; F. A. Lusk, Ida Grove, Ia.

Tyrone Electric Street Railway company, Tyrone, Pa.; capital stock, $300,000; constructing and operating an electric railway in Tyrone, Pa.; A. A. Stevens, Tyrone, Pa.

Milford Electric Light & Power Transmission company, Milford, Ill.; capital stock, $15,000; to erect, construct and maintain electric light and power plant; W. H. Mogg, Milford, Ill.

People's Street Railway company, Chester, Pa.; capital stock, $50,000; constructing and operating an electric railway in Chester, Delaware county, Pa.; John R. Hannum, Chester, Pa.

Rockport Electric Street Railway company, Rockport, Mass.; capital stock, $50,000; to construct and operate a railway by animal power or electricity, or any approved motive power other than steam.

Shenandoah & Mahanoy City Street Railway company, Ashland, Pa.; capital stock, $100,000; constructing and operating an electric railway in Schuylkill county, Pa; MacHenry Wilhelm, Ashland, Pa.

Cleveland Surgical & Electrical Instrument company, Cleveland, O.; capital stock, $25,000; manufacturing and dealing in surgical and electrical instruments, materials, etc.; Riley & McQuigg, Cleveland, O.

South Jersey Traction company, Bridgeton, N. J.; capital stock, $400,000; to construct and operate street railways or railroads operated as street railways and to regulate the same; W. H. Bacon, Bridgeton, N. J.

Fort Smith & Van Buren Electric Street Railway, Light & Power company, Fort Smith, Ark.; capital stock, $100,000; to build and operate an electric street railway from Van Buren to Fort Smith; Miles N. Beaty, Fort Smith, Ark.

Caracas Electric & Power company, Jersey City, N. J.; capital stock, $600,000; to construct, operate and maintain lines of electric wire, dynamos, poles, arc and incandescent lamps, etc.; Seward, Guthrie, Morawetz & Steele, New York, N. Y.

Lambertville Electric Light, Heat & Power company, Lambertville, N. J.; capital stock, $50,000; to sell, supply electric light, heat and power to persons desiring to purchase the same, etc.; G. W. Jacobs, Jr., 411 Walnut street, Philadelphia, Pa.

Allentown & Lehigh Valley Traction company, Allentown, Pa; capital stock, $1,500,000; constructing and operating motors and cables or other machinery for supplying motive power to passenger railways and apparatus for applying the same; Kauffman & Reninger, Allentown, Pa.

ELECTRIC LIGHTING.

Effingham, Ill., has voted $16,000 to buy an electric light plant.

The People's Electric Light & Power company, of Creston, Iowa, has been awarded the contract for the city lighting for a term of five years.

An artesian well is being sunk at Wildwood Beach, Pa., to furnish power for operating an electric light and railway plant which is shortly to be constructed.

A. A. Tibbe, superintendent of the electric light plant at Washington, Mo., is contemplating the introduction of an additional incandescent dynamo and engine for his plant.

Girard College, Philadelphia, Pa., is to have a complete electric lighting plant for the lighting of the building and grounds. An appropriation of $75,000 has been made for this purpose.

It is claimed that the new marine light which will soon be in place near Havre, France, will be the most powerful in the world. It will be visible at sea a distance of from twenty-two to fifty-two miles, according to the condition of the weather.

The manufacturing plant of the Canada Electric company of Amherst, N. S., has been sent to St. John, to augment the plant of the Consolidated Electric company. The Amherst company will henceforth confine its work to supplying light and power in Amherst.

The City Council of Belle Plaine, Ia., will receive sealed proposals until June 26, 1893, for lighting the city. The plant will have a capacity of at least twenty nominal two thousand candle power arc lamps, also for seven hundred sixteen candle power incandescent lamps.

The Edison Electric Light company of New York is excavating the foundation for an additional building in Pearl street contiguous to the present structure. It will be of brick, with a frontage of 75 feet, having a depth of 97 feet and a height of 50 feet. It will cost $50,000.

A boiler in the Eldora, Ia., electric light plant blew up last month, demolishing the building and two others. Dr. A. E. Gier was killed and several men were seriously injured. These works were completed about a year ago and cost $20,000. They were owned by Eldora business men and no insurance was carried. The total loss will probably reach $25,000.

ELECTRIC RAILWAYS.

A new electric railroad five and one-half miles in length is to be constructed at Calias, Me.

There is a project under consideration to construct an electric railway from Syracuse, N. Y., to Fayetteville.

The Norfolk Suburban Street Railway company has obtained a franchise for an electric road from Dedham Center to Hyde Park, Mass.

The Peekskill Surface Railway company, Peekskill, N. Y., will extend its lines to Lake Mohegan, Verplanck's Point and Van Cortlandtville.

It is understood that the Hot Springs, Ark., electric line will be extended to Oak Lawn and the Ouachita river, a distance of four and a half miles.

The City Railway company of Dayton, O., is constructing a new power house. About thirty-five miles is to be added to its electric railway system.

An electric road is to be built from Pleasure Bay, N. J., near Long Branch, to several towns and summer seaside resorts. The road is capitalized at $1,500,000.

The Montford avenue electric line of Asheville, N. C., has been sold to the Asheville Loan & Improvement company. It will extend it to the French Broad river.

It is said that the Terre Haute, Ind., electric street railway will be transferred to an eastern syndicate for $500,000, and that the company will build from eight to ten miles of extensions.

It is said that 1,000 miles of electric railroad will be put in this summer in Philadelphia. Work has been begun on the electric road that is to be built from Philadelphia to Harrisburg.

The Bergen Turnpike company, Hackensack, N. J., will build an electric railway from Hackensack to Hoboken. The trolley system will be used and the road will be nine miles in length.

The Fort Worth & Dallas Rapid Transit company of Fort Worth, Tex., will build an electric railway to connect with Dallas, and is asking a franchise from the city council of Fort Worth.

The citizens of North St. Louis are interesting themselves in projecting an electric road from a down town terminal through the northern part of the city to Jennings Heights and Walnut Hill, Mo.

A charter is asked in Rhode Island for the Newport, Middletown & Portsmouth electric road, which will extend to Tiverton from Newport, and then connect with the proposed line from Fall River to Taunton.

A movement is on foot among the business men of Mason, Bracken and Robertson counties, Ky., to secure stock and rights of way for a line of electric railway from Mt. Olivet to some point on the Chesapeake & Ohio road.

An electric street railway is to be constructed at South Waukegan, Ill., by a syndicate of Detroit and Chicago capitalists. The road is to be four miles in length and will extend to the manufacturing territory of South Waukegan.

The Nassau Electric Railway company, the Kings County Electric Railway company, and the Brooklyn City Railway company have made applications for franchises to operate electric surface cars along several streets and avenues of Brooklyn.

Considerable extensions to the electric lines in Milwaukee are contemplated and will shortly be begun, the Milwaukee Street Railway company and the Edison Electric company having gained control of the lines of the North American company.

About seventy miles of new electric railway tracking will be laid in and around Toronto this summer, for which over 300 new cars will be required. It is claimed that Toronto has one of the best operated electric car services in Canada. By next fall it will have 128 miles of electric car track and about 530 cars.

An electric street railway is now being built from St. Catharines, Canada, to Port Dalhousie, and will be running early in the summer. Dawson & Sims, the contractors, have bought the St. Catharines & Thorold electric road, which was the first of its kind in Canada, and will re-construct it. It is said another line will be run from St. Catharines to Niagara Falls.

TELEPHONE.

The Automatic Telephone & Electrical company of Canada proposes to run a copper metallic trunk line direct from Halifax to Vancouver, a distance of 3,500 miles. Local plants will also be established in towns and cities along the line.

The Providence Telephone company has begun the work of laying its wires underground. Under direction of Assistant Superintendent McClellan 318 feet of trenches has been dug, and over 1,500 feet of ducts laid from the corner of Plain and Point streets. The trenches are about four feet deep and situated midway between the water pipe and the curbstone. The ducts are laid five in a row, and each duct is equal to a capacity of 1,000 wires.

The largest center of telephonic communication in the United Kingdom, and one of the largest in Europe is that of Liverpool, where the National Telephone company has just completed its new switch room. This is a hall 90 feet in length, and is fitted in a way which completes nearly a million of telephonic connections, whereby each subscriber on the exchange may be placed immediately in connection with any other throughout the country. Already there are worked from the Liverpool center 9 600 miles of line, of which more than 7,000 are exchange and private wires. In 1882 the mileage of wires in Liverpool was only 463 miles; in February last it was 7,019. From the last published statistics it appears that the number of "calls" in the Liverpool center is 42,800 per day, representing a daily communication between 95,600 persons.

ELECTRIC MINING.

The Woodridge, Tenn., Jellico Coal company has contracted to put in an electric power plant and equip its mine with cars, etc., so as to do all the hauling by electricity.

The new Leavitt electric pumps with Thomson-Houston 1,000 volt motors and a capacity of 8,640,000 gallons in twenty-four hours were tested last month in the Calumet & Hecla electric light and power building, Calumet, Mich. The machinery worked well, coming fully up to the requirements in every particular. The pumps will be placed at the 33d level in Calumet No. 4 shaft. The electric pump in the South Hecla mine has been a success, giving perfect satisfaction. The Calomet & Hecla company owns a most extensive electric plant in its mines, and it has nearly every known form of electrical appliance in use. It has many miles of telephone lines on surface and underground, a complete telephone exchange and private line 'phones. In electric lighting it uses both the alternating and continuous currents with voltages ranging from fifty-two to one thousand. It also owns pumps, cranes, and some of the most perfect testing apparatus invented.

POWER TRANSMISSION.

In connection with the harnessing of Niagara Falls, the Hamilton Radical Electric Railway company of Hamilton, Ont., has been formed with the idea of using power transmitted from the falls to operate an extensive system of electric railways around Hamilton.

A claim on Nisqually Falls, Wash., has been filed by citizens of Tacoma, and a company is to be formed to expend $400,000 in building a power house and machinery to use the power of the falls in running electric plants in Tacoma. The estimated capacity of the falls is 10,000 horse power.

MISCELLANEOUS.

The apparatus for the electric fountain in Lincoln Park, Chicago, is now being replaced for the summer, and it is expected that this attraction will be open to the public the latter part of next week.

A recent dispatch from Asbury Park says that the new electric launch Bonaventure, which is to run on Deal Lake, made its trial trip on May 27th. It is 36 feet and 4 inches long. There are 120 storage battery cells in the vessel.

Madison Buell gave a brief and entertaining sketch of the career of Sir Humphrey Davy before the Buffalo Electrical Society on the evening of May 19th. Mr. Buell's paper was full of interesting matter and was received with pleasure.

At the recent convention of the Order of Railway Telegraphers at Toronto, Ont., it was decided to hold the next convention in Denver, Colo., in May, 1894. The association now numbers 26,000 members and holds $50,000 reserve in the protective fund.

The trustees of the Pueblo WaterWorks, Pueblo, Colo., recently closed a contract with the street railway company for the erection of an electric fountain, to be located at the Colorado Mineral palace. It will throw one stream 100 feet high and four others 75 feet high.

A new comer in the field of trade journalism is the *Canadian Engineer*, published in Toronto and Montreal, and devoted to the mechanical, mining, marine, locomotive, sanitary and other branches of engineering. The initial number comprises 28 pages and contains practical, bright and interesting articles. A special feature of this periodical is its Canadian news budget.

A press dispatch from Iowa City, Ia., dated June 2d says that the strike of the operators on the Chicago, Rock Island & Pacific railway last December Iowa City was made headquarters for many of the discontented men. At one time the wires of the affected railway were badly cut near that city and business much delayed. Three of the strikers, Albert Boone, C. W. Swords and William Jones were arrested, but on a preliminary examination were discharged. Boone and Swords at once began suit against the railway company for damages for large sums for false arrest. The cases are still pending, but last week Boone went before the court and pleaded guilty. The sentence was deferred.

One of the features of the equipment of the new armored cruiser New York will be an electric gig for the commanding officer, Captain John W. Phillips. It is being constructed by the General Electric Launch company and will be thirty feet long, six feet ten inches beam, and twenty-two inches draft. It will be capable of making a speed of about seven miles an hour for six or seven hours, with one set of storage batteries, although faster time can be made for a less number of hours. Her motive power will be sixty-four storage batteries, and the motor, placed under the floor of the cockpit, is directly connected to the Tobin bronze propeller shaft that is placed beneath the flooring.

TRADE NEWS.

The University of Pennsylvania has issued its annual catalogue. This institution has established quite an extensive course in electrical engineering.

The La Roche Electric Works of Philadelphia, in consequence of its growing business, is now making arrangements for increasing its manufacturing capacity.

Frank W. Harrington, who has been in charge of the Chicago office of the New York Insulated Wire company since November, returned last week to New York.

Manager A. C. Clark, of the Eastern Electric Light & Storage Battery company of Lowell, Mass., reports increased sales during the month of May for the Sorley storage battery over any month since the first of the year.

President E. F. Phillips, of the American Electrical Works of Providence, R. I., was in New York last week. He reports that work is progressing rapidly on the new factory which the company is erecting, and that business is brisk.

The Joseph Dixon Crucible company of Jersey City, N. J., is sending to its patrons a one-fold leaflet in which is contained the letter code of its grade stamps for the "Dixon" pencils, and also giving the uniformity of grading for use in offices, schools, counting rooms, etc.

The Novelty Electric company's new direct current 110 volt desk fan motor is meeting with large sales, being of high speed, very efficient and handsome in design. The company is also filling a number of orders for its alternating current desk fan motors. The fans are adjustable to any position desired.

General Manager E. S. Boggs, of the New York Electrical & Development company, reports increasing orders for his company's automatic electric lighter, and that it is very busy in the experimental and repair department on apparatus such as fan motors, dynamos, etc., which the company recently took up as a new department.

E. B. Duncan and J. S. Palmerlee have formed a partnership to engage in the electrical supply business in El Paso, Texas. Mr. Duncan was formerly with the Edison General company and in the office of the General Electric company at Louisville, Ky. Mr. Palmerlee is owner of the El Paso District telegraph and fire alarm system.

Large sales of Habirshaw wire during the past week are reported as having been made by the Ansonia Electric company, formerly the Electrical Supply company, Chicago. The good work done by the Wirt brush in saving commutators seems to be appreciated by the customers of this company, judging by the growth of the sale of the brush.

The Central Electric company is getting in large consignments of okonite, and is filling its orders promptly. The sales of okonite for the last month have been satisfactory, and the factory has had more than it could do to keep up with the demand. By increasing its facilities, adding new machinery and working overtime, it has been able to get abreast of the demand.

The Ries Electric Specialty company of Baltimore is very busy in pushing the manufacture of the new Reis & Scott single phase alternating current electric motors, which it is now making in sizes ranging from one-eighth to five horse power. These motors embody new features and are said to have many advantages. A modified type of this motor is made for fan work, of which the one-eighth and one-fourth horse power sizes are now ready for the market.

The Link Belt Machinery company extends an invitation to the trade to visit its works at the corner of Thirty ninth street and Stewart avenue, Chicago, and inspect its facilities for the manufacture of approved labor-saving machinery for transporting any material in bulk, or in boxes, barrels, bales and casks. This company, at whose works at Indianapolis, Ind., are manufactured all of the Ewart detachable link belting and Dodge chains, also owns a manufacturing plant at Chicago, where is made various kinds of general machinery as well as its link belt specialties. The company has an exhibit of freight and coal handling machinery in the transportation building annex, World's Fair, which is most interesting and illustrative of the company's devices.

Prof. C. B. Thwing, the university extension lecturer, and B. B. James of Evanston, Ill., are about to begin a series of lectures at the Chicago Athenæum, 26 Van Buren street, on the electrical exhibits at the World's Fair. The course will include four lectures, each lecture being designed, however, to be as complete as possible in itself. Prof. Thwing will speak on experimental exhibits and Mr. James on those pertaining to applied electricity. In addition to the lectures, these gentlemen will guide groups of from five to ten persons through the electrtity building, explaining the principal displays, noting their points of interest and importance. The lectures will be given upon every Monday and Wednesday evenings from seven to nine o'clock, and will no doubt prove of great interest.

BUSINESS.

The Wirt indicators, Wirt brushes and W. W. lightning arrestors, manufactured by the Ansonia Electric company, are attracting considerable attention from foreign visitors at the fair.

The Central Electric company reports having a run on fan motors. The Lundell motor made by the Interior Conduit & Insulation company, New York, which the Central company handles, is recognized as the most compact, noiseless and proper machine for keeping cool, and a big stock is carried, customers being supplied promptly.

The Henry R. Worthington company, of New York, had on exhibition in its office last week a set of pictures showing exterior and interior views of the Worthington Hydraulic Works at Brooklyn and Elizabethport, N. J. The pictures were bromide enlargements from original plates made by George P. Hall & Son, and are exceptionally fine pieces of photography. These pictures are to form part of this company's exhibit at the World's Fair. This company has about 65 distinct types of pumping engines at the fair, which pump about 80,000,000 gallons of water each day for use in different parts of the fair.

Last month the Waukesha Hygeia Mineral Springs company completed the line from the springs at Waukesha to the World's Fair grounds. The main line is over 100 miles long and the connections over 40 miles. The entire line is coated inside and out with the No. 1 P. & B. pipe coating compound, which, as reported by the company's chief engineer, J. W. Alvord, was the only material that would admit the piping of this water without imparting some disagreeable flavor. In fact Mr. Alvord says that but for the P. & B. pipe coating compound, the enterprise would have had to be abandoned. Reports from prominent chemists will shortly be published, giving full and critical analysis of the quality of the water, which as a matter of fact now reaches Chicago through the pipe line purer and fresher than when it was put into cans at the Springs and shipped to Chicago. The No. 1 P. & B. pipe coating compound is prepared by the Standard Paint company of New York city. The Chicago office is at 871 Rookery. This compound has attracted the attention of engineers and corporations interested in pipe coating on account of its great adhesive qualities, coupled with its odorless and tasteless properities.

ELECTRICAL PATENTS.

Issued May 30, 1893.

498,236. Telephone System. Emery A. Clark, Sioux City, Ia.

498,269. Electric Arc Lamp. Louis Hills, New York, N. Y.

498,289. Electrical Signaling System. Alfred S. McCaskey, Chicago, Ill.

498,290. Railway Block Signaling System. Alfred S. McCaskey, Chicago, Ill.

498,291. Automatic Telephone Exchange System. Alfred S. McCaskey, Chicago, Ill.

498,309. Telephone Transmitter. Charles F. Scattergood, Albany, N. Y.

The transmitter comprises a tube bent into U shape, one end of the tube being closed and free to vibrate, and the other fixed and opening into the speaking piece. The vibrations of the air produced by the voice cause the end of the tube to correspondingly vibrate. A button carried upon the free end of the tube bears against a carbon electrode included in an electric circuit with the button, the vibration thus produced causing the desired variation in resistance of the electric circuit.

498,312. Electric Lighting System. Charles E. Scribner, Chicago, Ill.

The system comprises means for controlling a lamp from two or more different points, so that at either the lamp may be turned on or off independently of the position of the switching devices at other points. When, for instance, it is desired to arrange a lamp so that it may be turned on or off from two distinct stations, a pair of contacts is provided at each station, the contact points being respectively connected together. The contact arm of one switch is connected to one side of the mains, and the contact arm of the other switch is connected to the other side after passing through the lamp. By this arrangement circuit through the lamp can be completed or broken by movement of the switch arm at either station.

498,327. Pole Piece for Dynamo-electric Machines. Elihu Thomson, Swampscott, Mass.

498,355. Trolley Catcher. Charles A. Lord, San Francisco, Cal.

498,372. Electric Registering Device. Barton B. Ward, New York, N. Y.

498,374. Adapter for Lamp Sockets. Henry P. Ball, Schenectady, N. Y.

498,387. Electric Arc Lamp. Frederick D'A. Goold, New York, N. Y.

498,407. Insulated Binding Post. Richard H. Rich, Beverly, Mass.

498,422. Galvanic Battery. William Burnley, North East, Pa.

The battery comprises an outer casing of zinc forming one electrode of the battery and an inner electrode surrounded by granulated carbon, filled in around the inner electrode loosely. Between the carbon and the zinc casing is included a plastic material containing the active substance for the battery. The object of the construction is to increase the surface of the positive element, thereby rendering the battery of longer active duration, since the surface of the positive element equals that of the solid electrode plus the surfaces of the various particles of granulated carbon. A large surface being thus presented, the battery will run longer without becoming polarized.

498,435. Electric Railway Trolley. Rudolph M. Hunter, Philadelphia, Pa.

498,437. Clearer for Slotted Conduits. John C. Love, Chicago, Ill.

498,448. Fire Alarm System. Joseph Sachs, New York, N. Y.

498,462. Electric Rotary Fan. Julian F. Denison, New Haven, Conn.

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498,537. Dynamo-electric Machine. Charles E. Dressler, New York, N. Y.

498,538. Electric Generator or Motor. Charles E. Dressler, New York, N. Y.

498,539. Junction Block for Electric Fixtures. Frederic A. Duggan, Trenton, N. J.

498,550. Mail Receptacle. Andrew Holtum, Racine, Wis.

498,560. Electric Cut-out. William P. Mashinter,

498,566. Electric Arc Lamp. Paul Nordmann, Berlin, Germany.

The lamp is designed for use upon constant potential circuits, in which the potential is greater than that required for the lamp, and in which it has been usual heretofore to include resistances in circuit with the lamp. Two or more arcs are produced and regulated by the same feeding mechanism, the various arcs being included in series.

498,570. Suspension Device for Electric Lamps. James J. Renehan, New Britain, Conn.

498,573. Automatic Cut-off for Musical Instruments. Constantin Riegger, Louisville, Ky.

498,577. Electric Locomotive. Albert Schmid, Allegheny, Pa.

The motor frame is made in two parts, one part being hinged to the support at one end of the motor and the other part hinged to the support at the other end.

498,585. Electrical Rotary Motor. William J. Still, Toronto, Can.

498,603. System of Supplying Currents to Electric Railways. Charles Zipernowsky.

The system consists of an alternating current generator at the supply station connected with high tension mains extending to the consumption stations, at which points are provided transformers, consisting of an alternating motor in circuit with the high tension alternating mains and a continuous current dynamo, the armature being connected together in circuit with the secondary or low tension mains. Alternating currents, which are more cheaply transmitted long distances, are thus used on the high tension mains, and continuous currents, the more readily utilized for motor work, are used on the low tension or consumption mains. In order to start up any transformer continuous current from the common consumption circuits are sent through the dynamo, thus causing it to run as a motor until the speed is such that the alternating current motor may start when the dynamo acts to supply current to the consumption circuits.

498,604. Electric Arc Lamp. Hugh Alexander, Brooklyn, N. Y.

498,607. Operating Street or Station Indicators. Ruben B. Ayres, New York, N. Y.

498,624. Electric Car Brake. Nicholas J. Clute, Schenectady, N. Y.

498,674. Printing Telegraph. Donald Murray, Sydney, New South Wales.

498,710. Electric Time Alarm. Charles S. Gibson, South New Berlin, N. Y.

498,722. Trolley for Electric Cars. Robert D. Nuttall, Allegheny, Pa.

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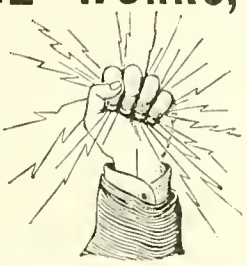

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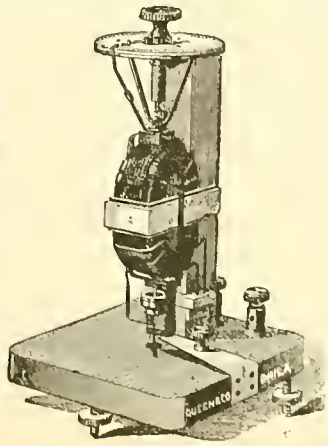

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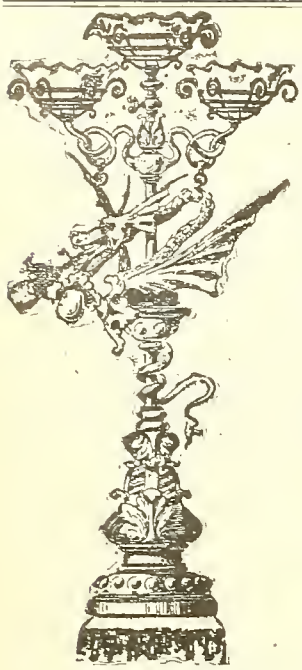

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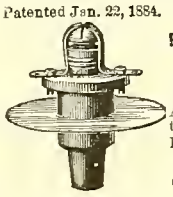

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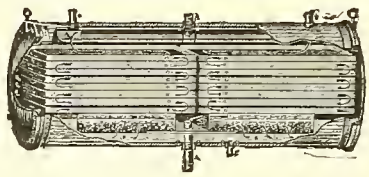

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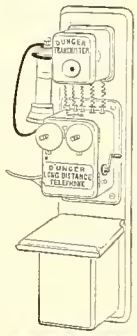

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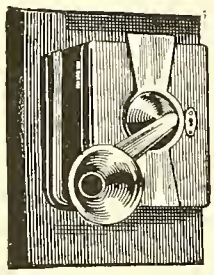

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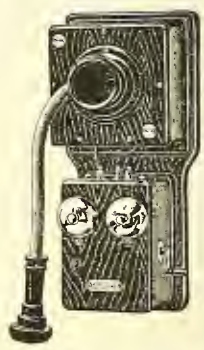

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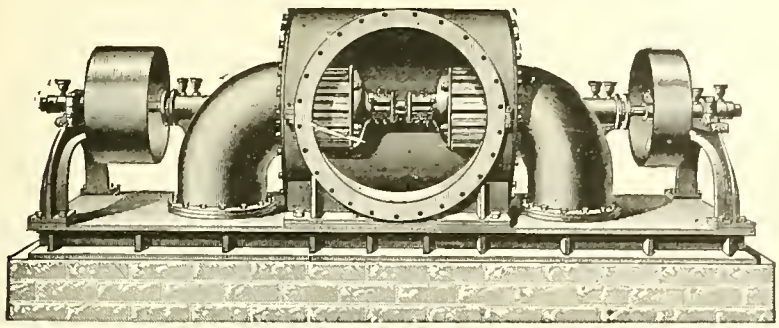

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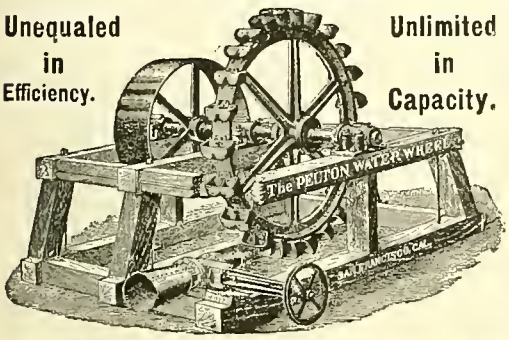

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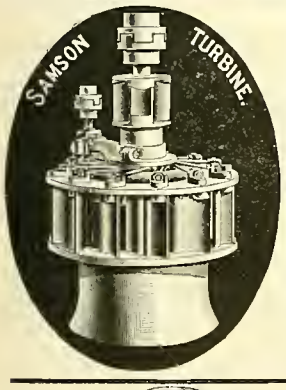

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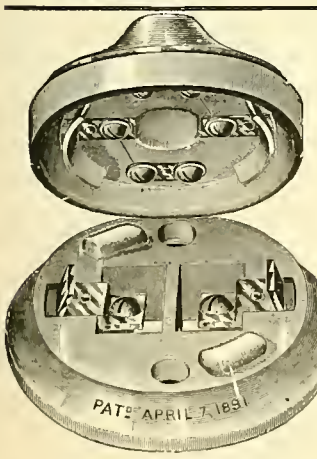

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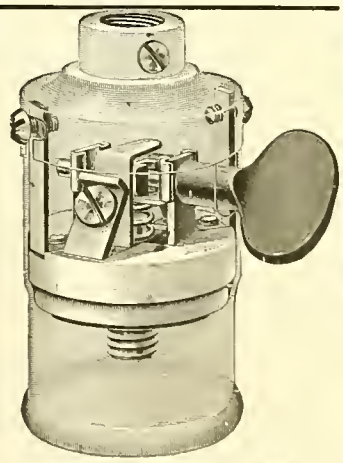

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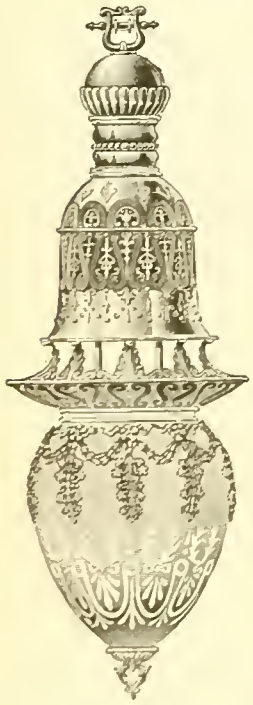

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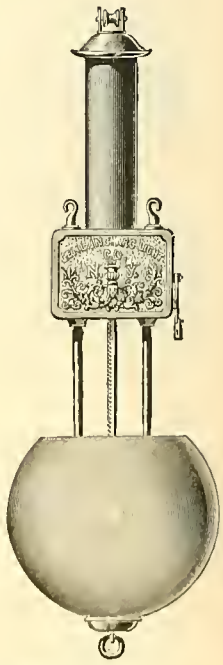

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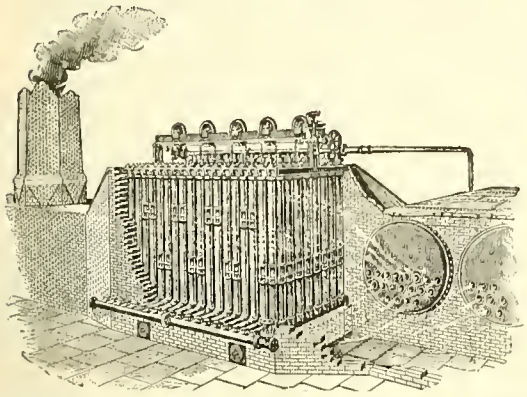

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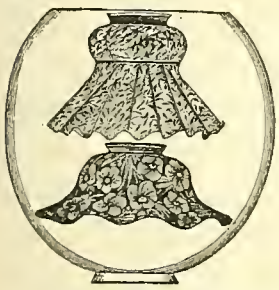

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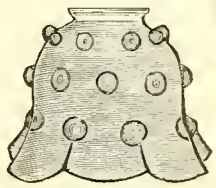

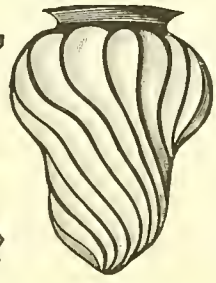

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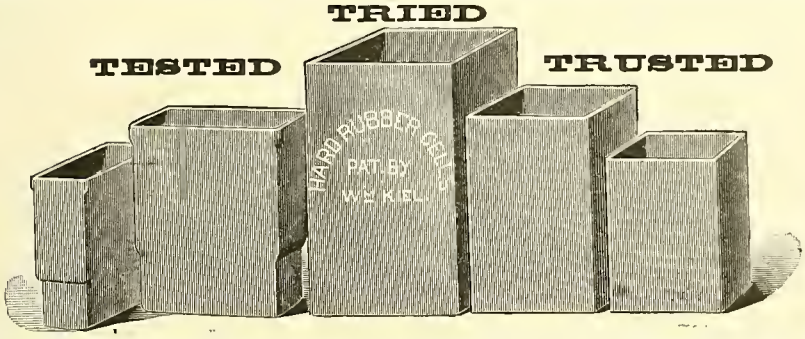

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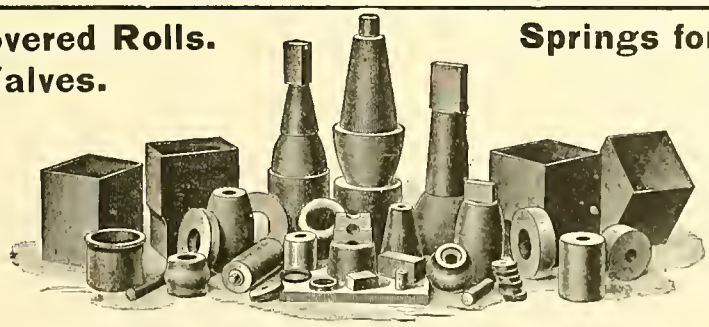

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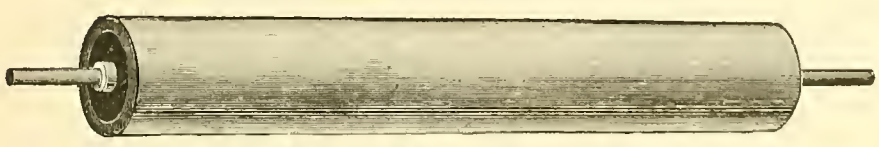

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Said railway property and franchises consist of about 61¼ miles of double track, being about 13 miles of single track, in said city of Milwaukee, with all the poles, wires, cables, trucks, ties, stringers, fixtures and appliances composing or used in connection with said tracks or said railway, with franchises, privileges and rights derived from ordinances of the common council of the city of Milwaukee to maintain and operate said road; also sundry parcels of real estate in said city, with car barns and power house thereon; also the engines, boilers, machinery and rolling stock and supplies of said road.

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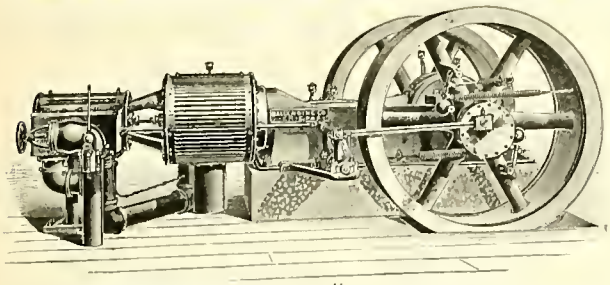

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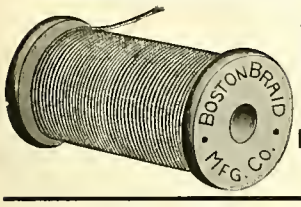

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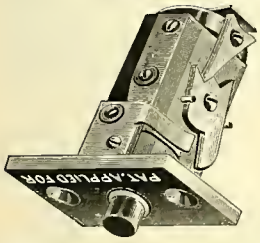

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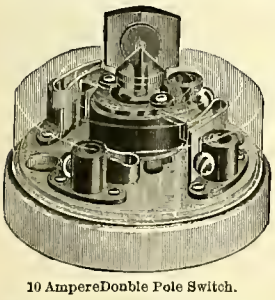

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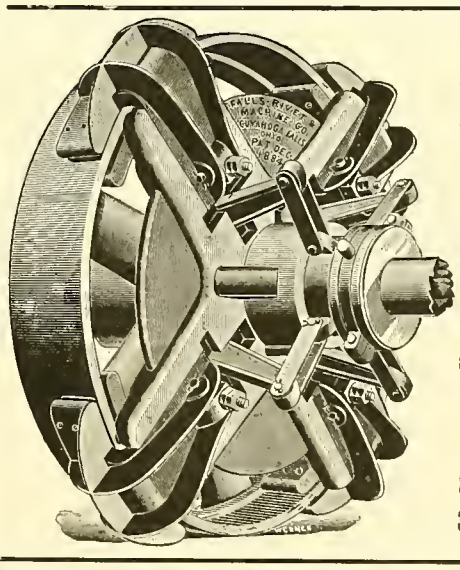

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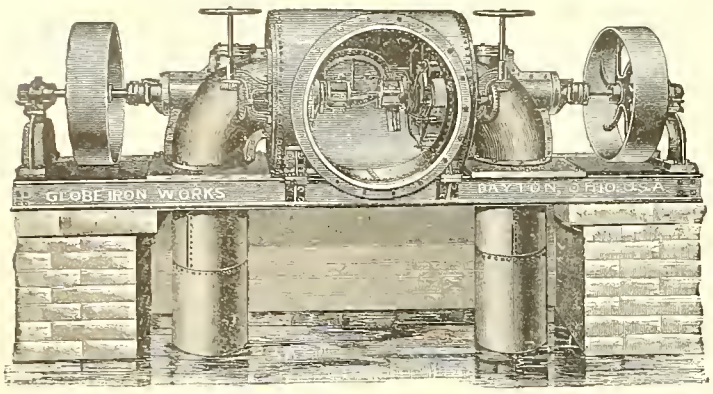

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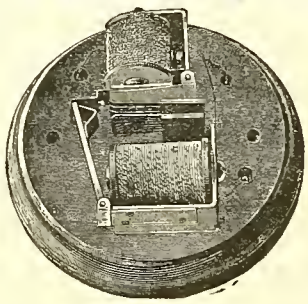

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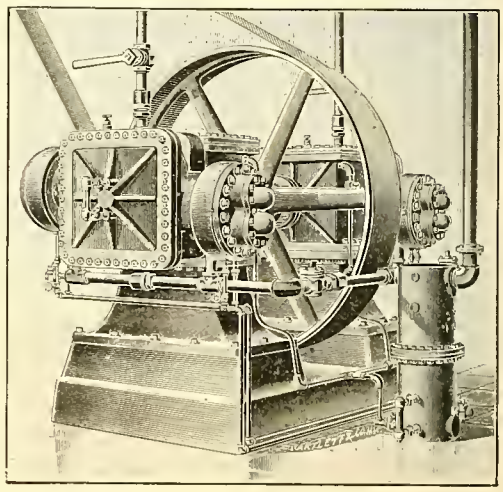

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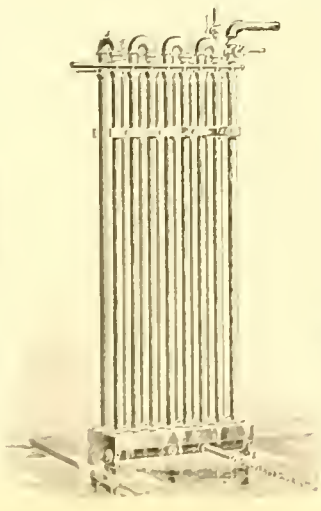

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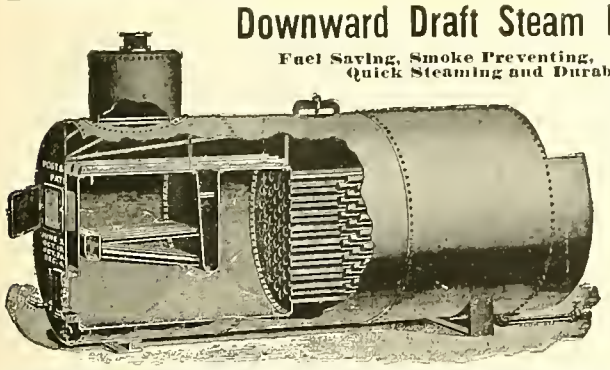

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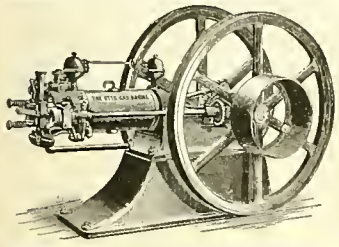

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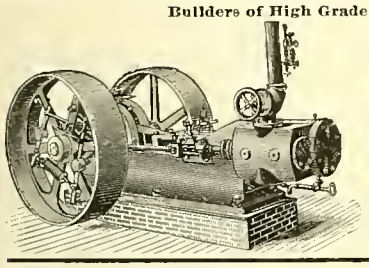

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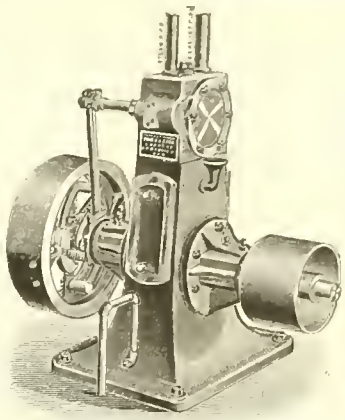

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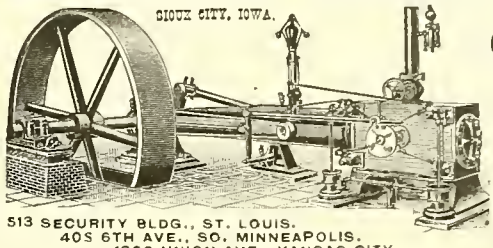

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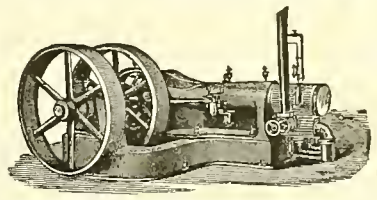

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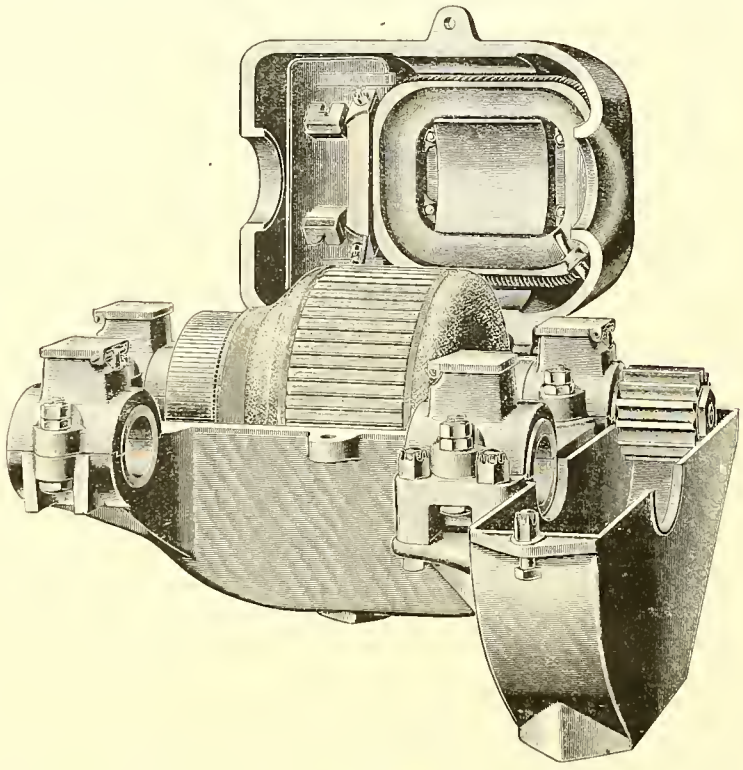

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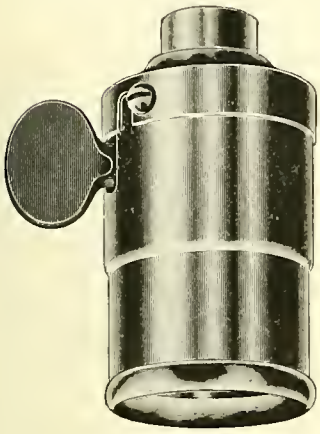

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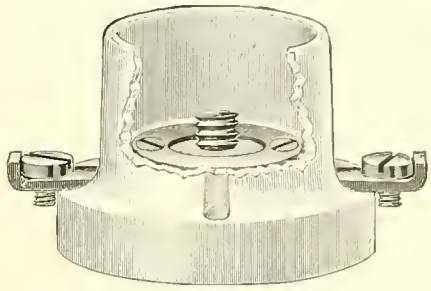

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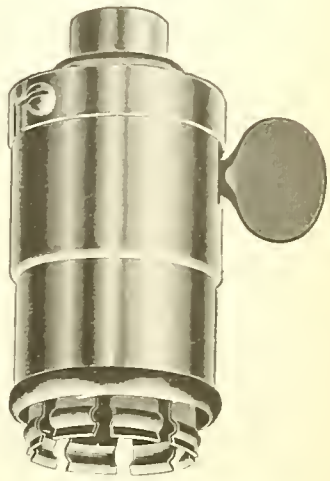

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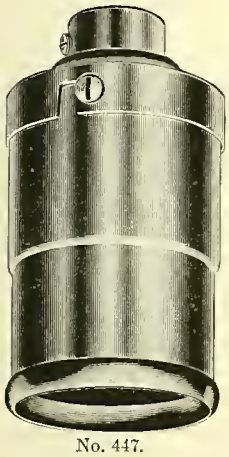

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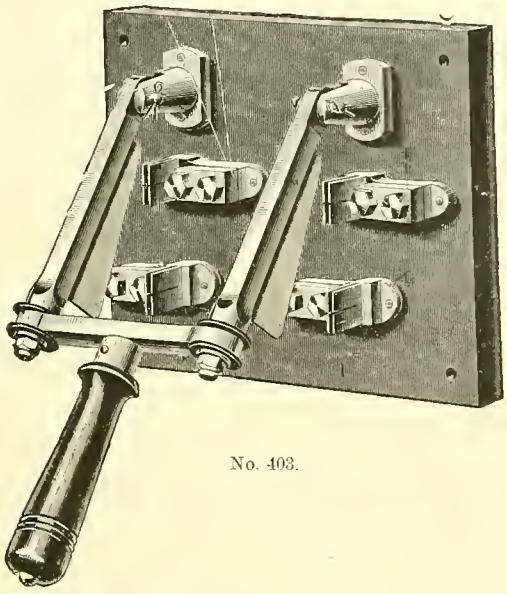

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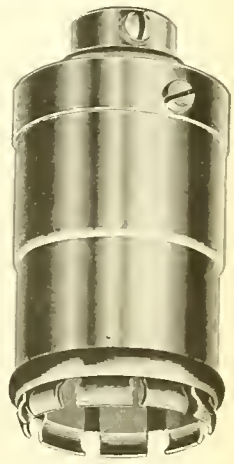

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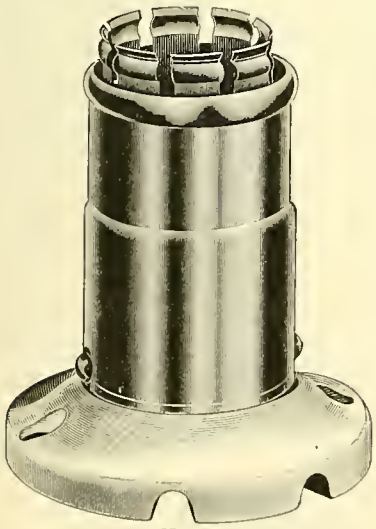

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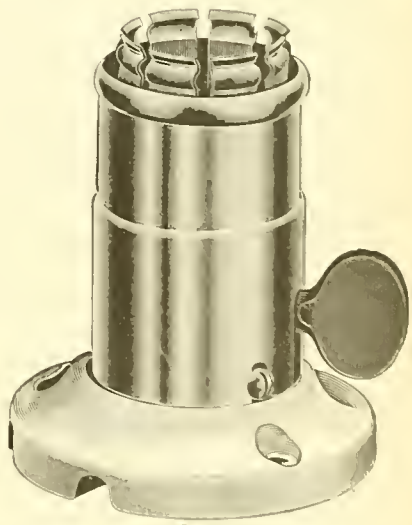

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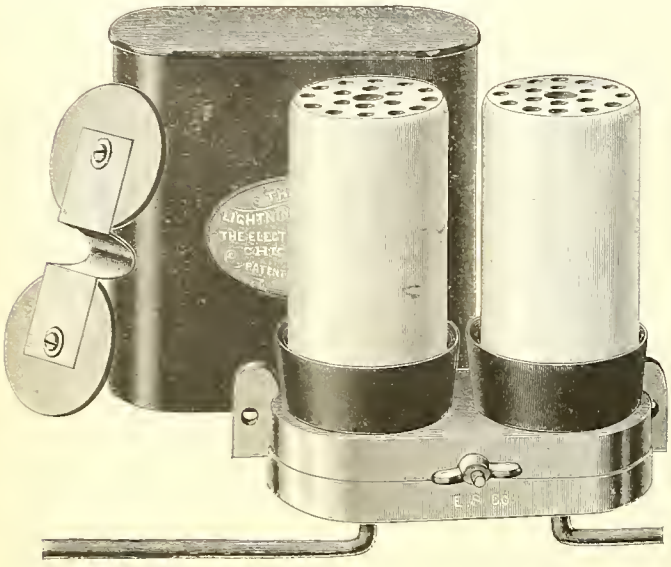

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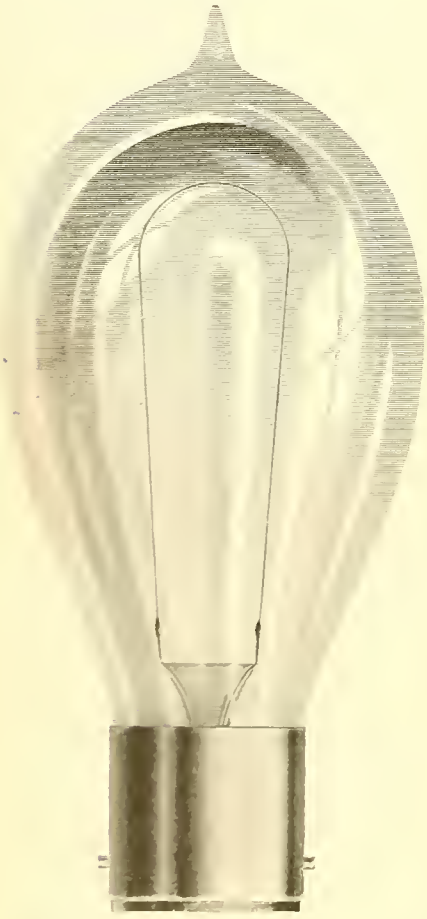

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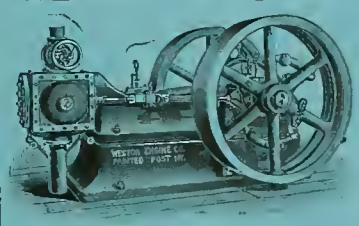

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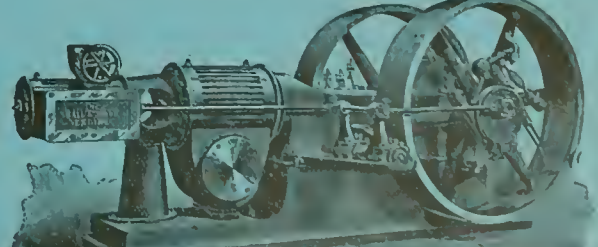

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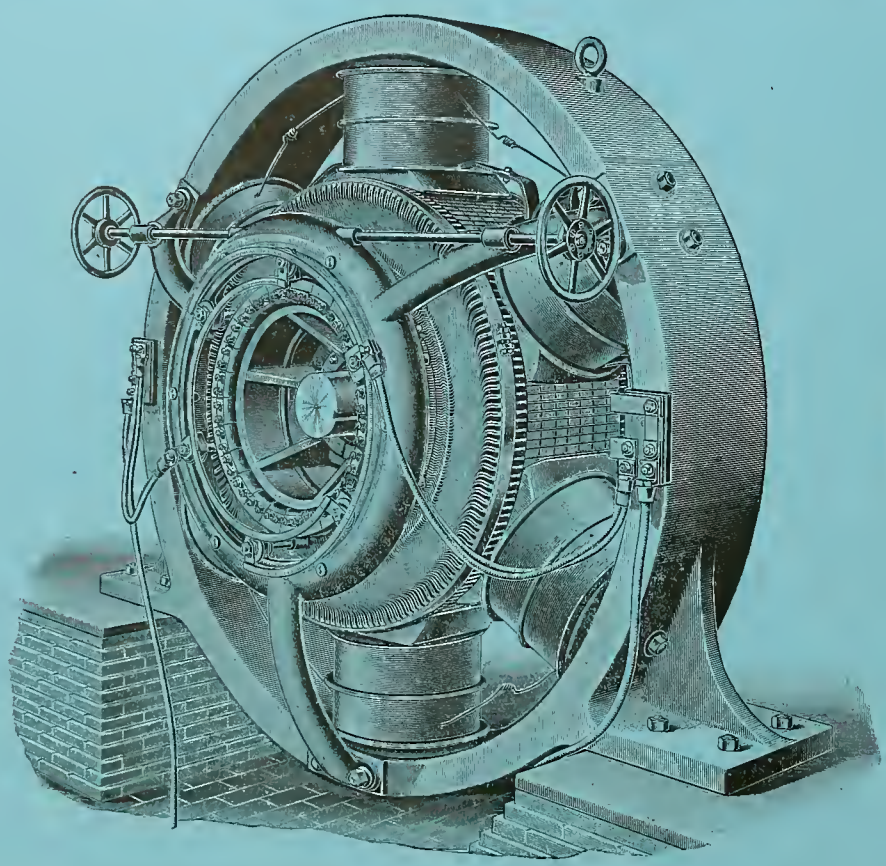

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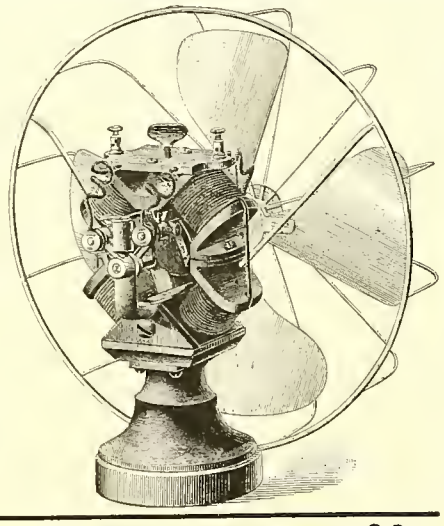

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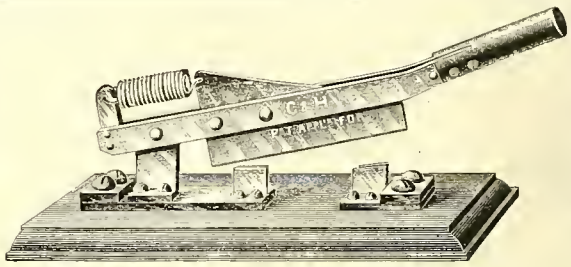

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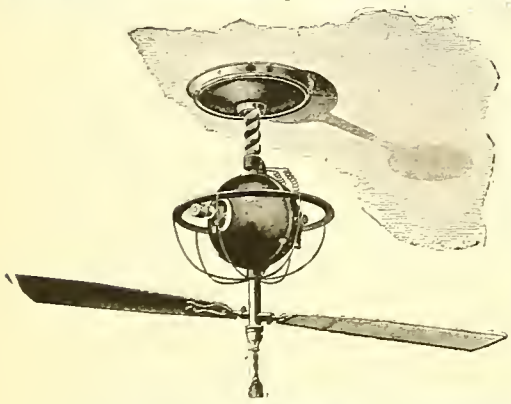

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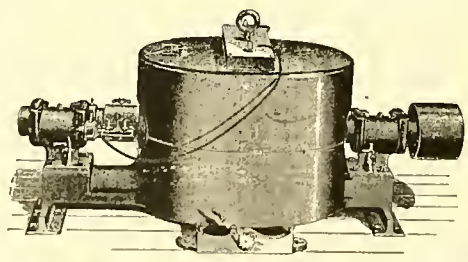

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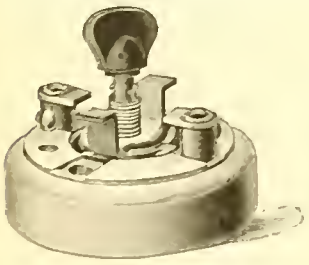

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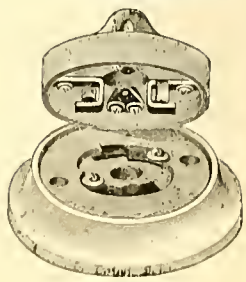

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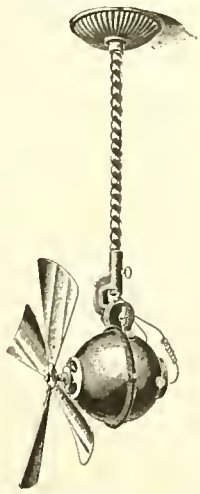

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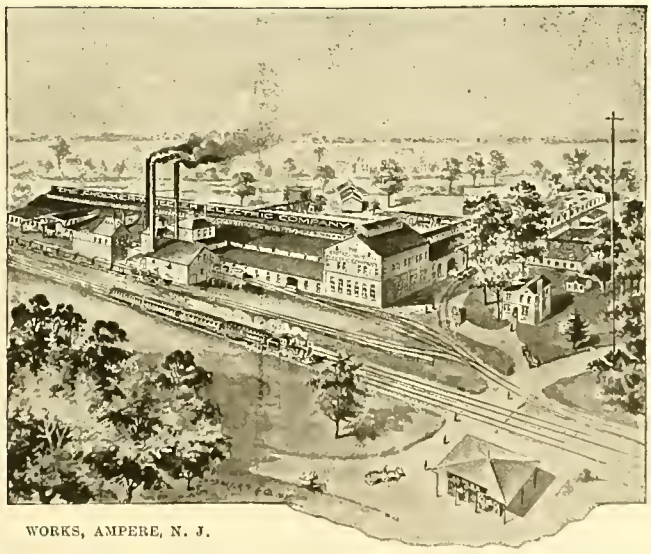

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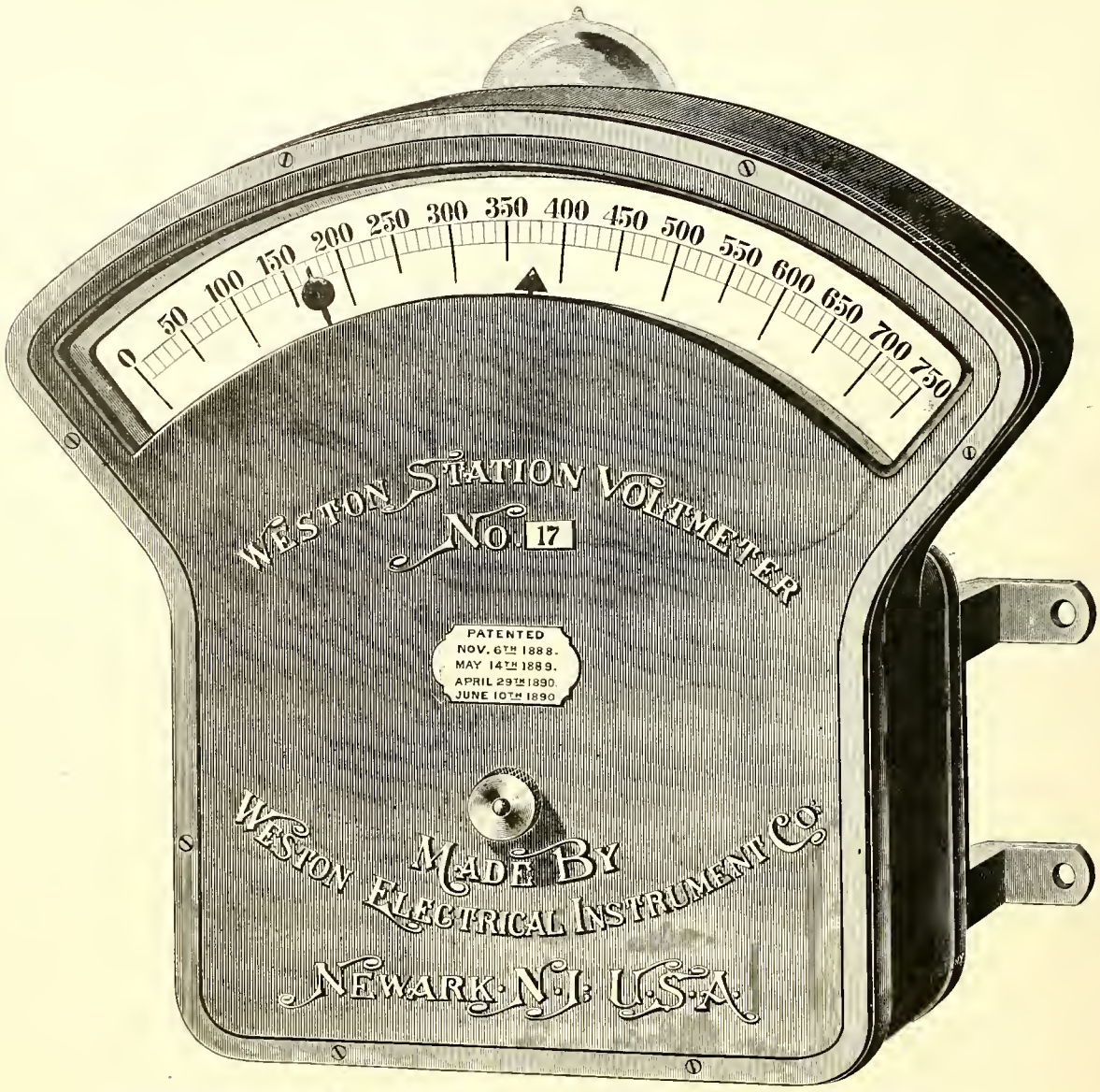

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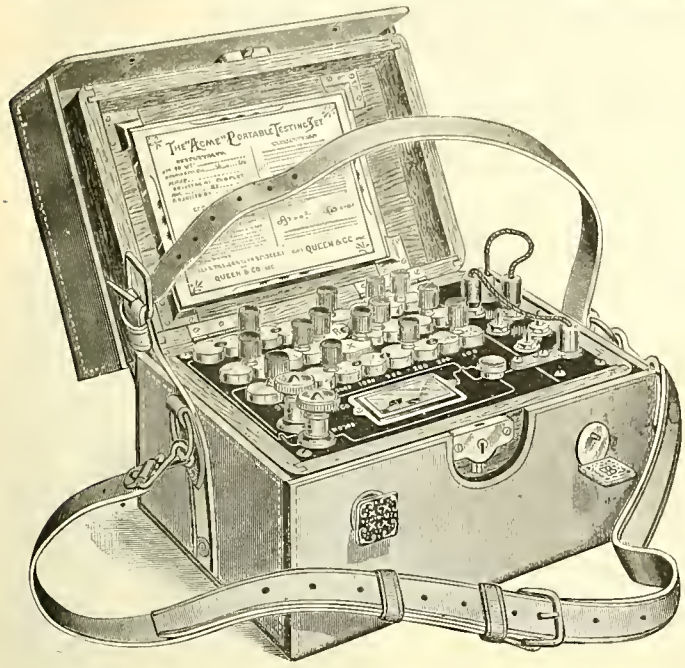

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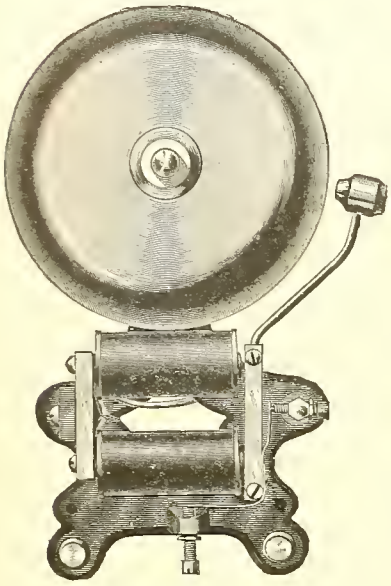

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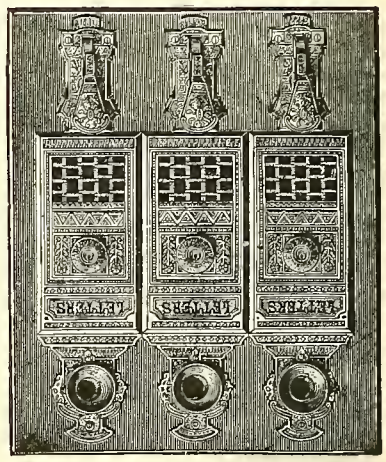

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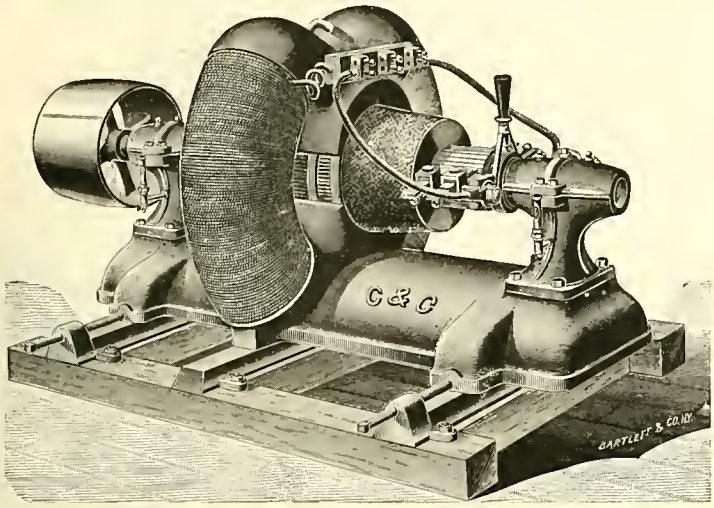

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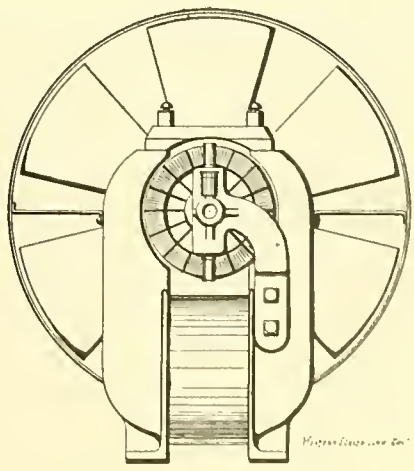

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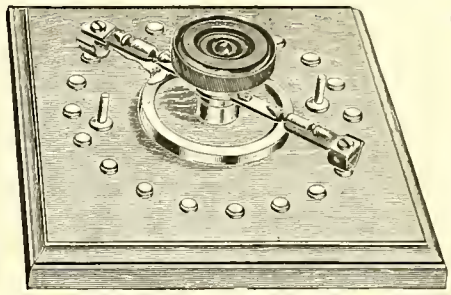

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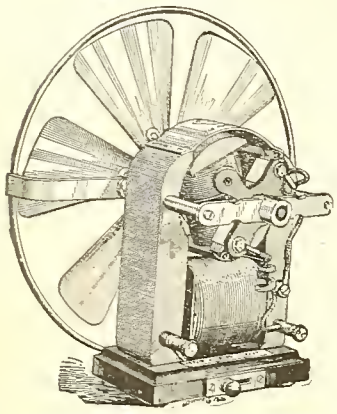

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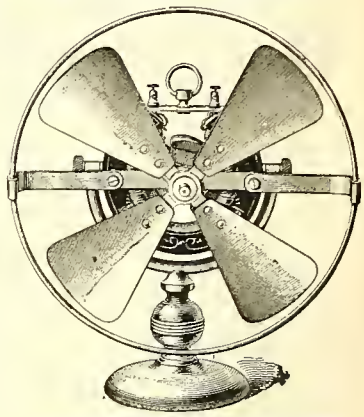

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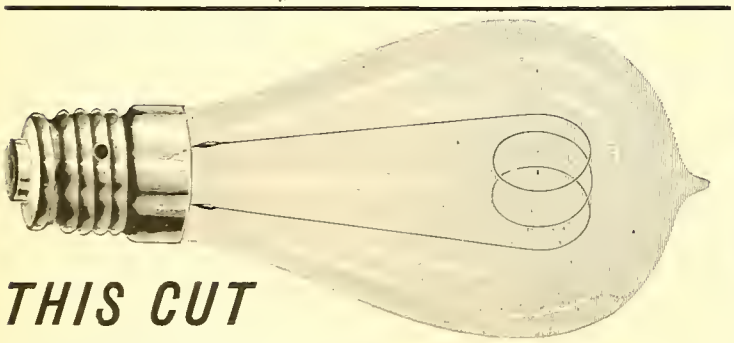

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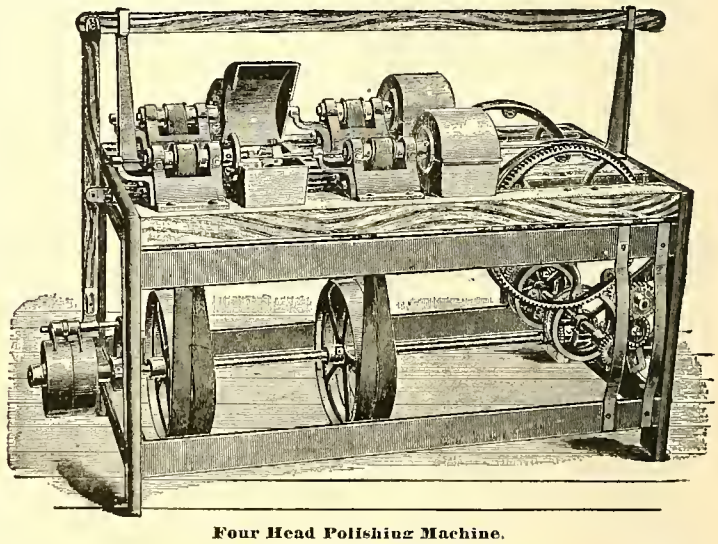

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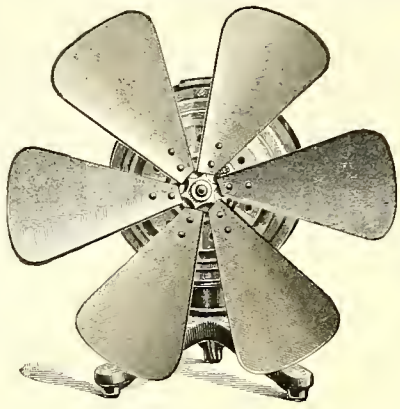

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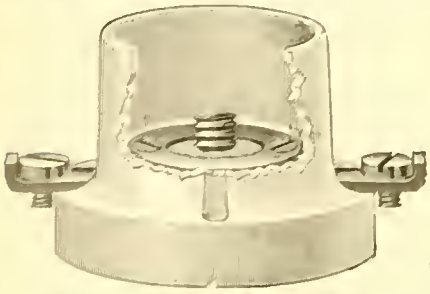

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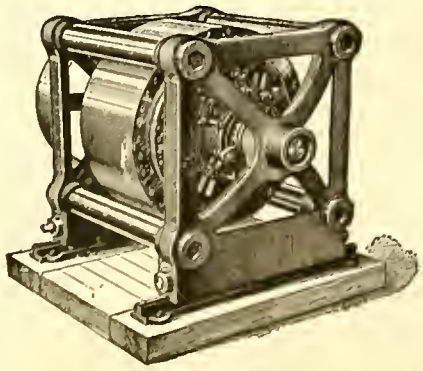

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Electricity at the World's Fair.

Among the noteworthy electrical features at the World's Fair one of the most remarkable is the five-foot Schuckert search-light projector which is mounted on the northwestern corner of the roof promenade on the manufactures building, and which is in operation on every Tuesday, Thursday and Saturday evening. There seems to be no question that this is the largest projector ever made, and it is asserted that the light from it will be easily seen, under favorable conditions, at Milwaukee, over eighty miles away.

This lamp, which was made especially for the World's Columbian Exposition, was manufactured by Schuckert & Co., of Nuremberg, Germany, and is in charge of Fred W. Tischendoerfer, the World's Fair representative of this firm. Completely mounted, it stands about eight and one-half feet above the platform on which it is erected. An idea of its size may be gained by comparison with the man standing beside it in the illustration. The parabolic mirror, which perhaps constitutes the most important part of the lamp, has a working diameter of five feet with a thickness of about 7/8 of an inch, and six

The feed of the carbons, which are placed in the lamp in a direction parallel to the axis of the drum, is automatically accomplished, and a device is also provided by means of which the carbons are separated and the arc established automatically, so that it is only necessary to turn on the current to get the full force of the light at once. The positive carbon is 33 millimeters in diameter and the negative carbon 26 millimeters. The lamp can be worked by hand, as is done at present, or by means of electric motors placed under the base of the stand, which can be operated some distance away if

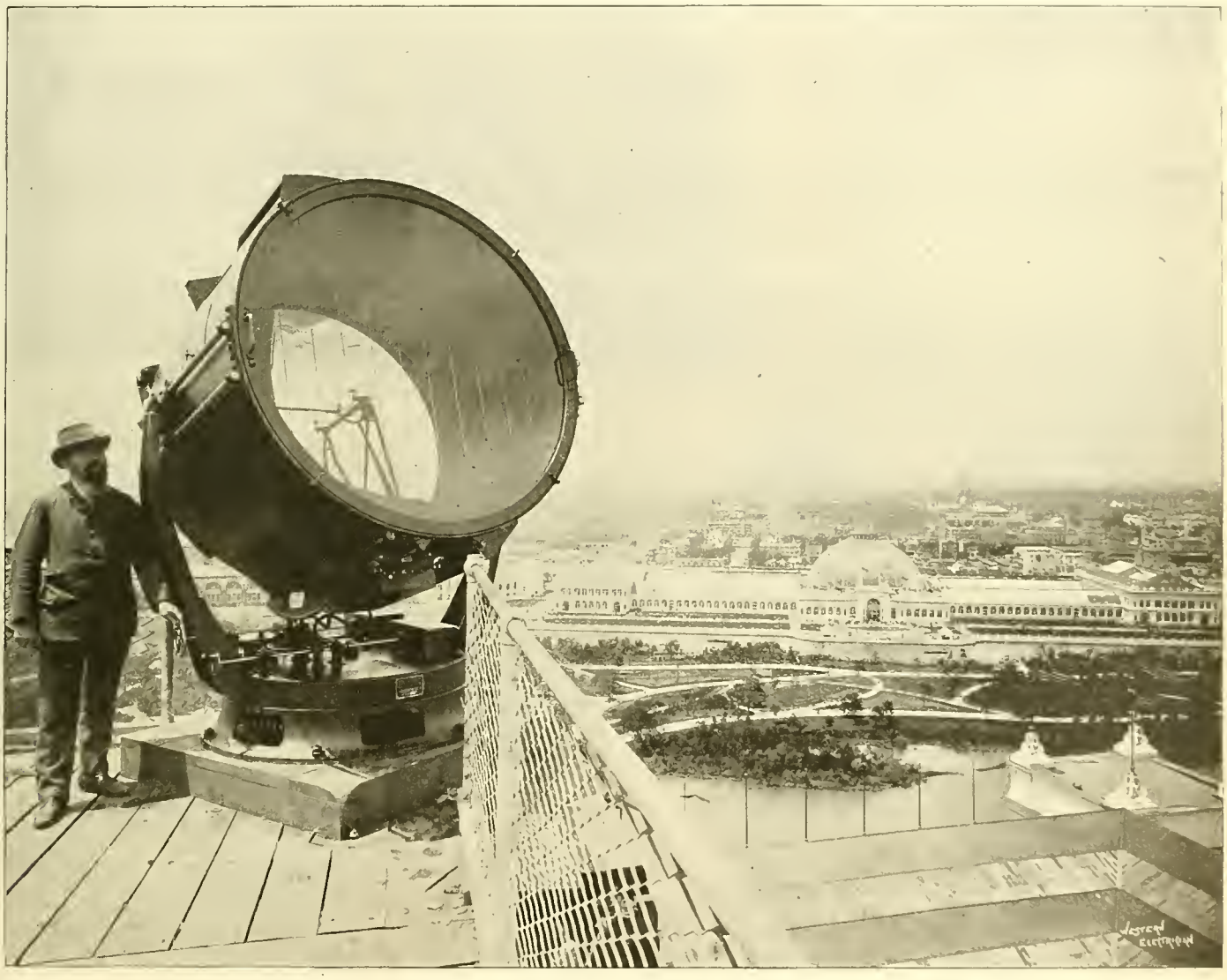

FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.—THE GREAT SCHUCKERT PROJECTOR ON THE MANUFACTURES BUILDING.

The illustration on this page shows the big lamp as mounted in its present position. The background is formed by the view of the exposition grounds and surrounding country visible from the lofty perch, 230 feet above the ground, on which the search-light is placed. The building most prominently shown is horticultural hall, in front of which the winding paths of the wooded island can be plainly discerned. To the right the lofty structure of the Ferris revolving wheel can be easily distinguished. At the time the photograph was taken the projector was pointed in such a direction that an inverted reflection of the battle-ship and the British government building could be seen in the parabolic mirror. This also may be detected in the reproduction by the close observer.

months was consumed in the labor of grinding and polishing it. The back is heavily coated with silver, protected by a specially prepared paint. The mirror is fastened by springs in the drum so as to provide for expansion due to the heat. Exhaustive experiments have demonstrated that the parabolic glass mirror is the most perfect method for projecting the rays of an arc lamp for search-light purposes, as it not only takes up the greater part of the rays from the crater of the arc, but is also best adapted for the reflection of the most intense rays. It utilizes in the highest degree and with the greatest efficiency the useful spheric angle of the light. It seems therefore to be assured that whatever improvement may be made in search-lights in the future the parabolic mirror will form an integral portion of the mechanism of the lamp.

necessary. In order to secure the best effect and a steady light the positive carbon is made with a core of soft glass, thus producing at all times a regularly proportioned crater. The ratio of the cross-sections of the positive and negative carbons is such that both are burned away equally, thus keeping the focus of the lamp always in the same position. Means are provided, however, by which the focus of the lamp can be easily changed to obtain divergence of the rays, convergence or a beam of concentrated light. The arc can be seen from the outside of the drum by means of angle mirrors and colored glass slides and is thus capable of easy regulation. The drum containing the mechanism of the lamp presents a dull black surface both inside and out. It is thoroughly ventilated in a manner which does not affect the arc and at the same time prevents over-heat-

ing of the mirror. It can be turned in any direction, either horizontally or vertically. The current is supplied from a dynamo in machinery hall, the feeders being laid in subways to the manufactures building, where they are conducted upward on the iron trusses supporting the roof.

The current strength for the big lamp is 150 amperes at a potential of 60 volts at the lamp terminals, and No. 0000 wire is used for the conductors. It is calculated that the strength of the arc itself is 47,000 candle power, which is magnified on the surface of the mirror to 194,000,000 candle power.

Beside the big projector the firm exhibits three other search-lights on the roof of the manufactures building, with projector diameters of respectively four, three and two feet. Each search light is provided with an adjacent switch-house, equipped with a water-proof cover, containing resistance coils, measuring instruments, safety fuses, cut-outs and tools used about the lamps. Two of the lamps are as yet unprovided with feeders, but in a short time all four will be in operation three nights every week. As soon as the weather is clear Mr. Tischendoerfer purposes to make some tests to display the strength of the light from his big lamp, and it is confidently expected that some astonishing results will be obtained.

The large electric sign of the Westinghouse company on the southern wall of the electricity building is nearing completion, and a good idea of its final appearance may now be gained. The central feature is a massive head of Columbus, closely studded with incandescent lamps, so that at night the features of the great discoverer will stand out as a picture of light. The flesh tints are represented by pink lamps, the hair by white and the frock by blue. The portrait is 18 feet high. Above it, arranged in a semi-circle, are the words, "Westinghouse Electric & Manufacturing Co.," while below is the name 'Columbus," with "1492" and "1892" on either side. The lettering is outlined by lamps of clear glass. The decoration can hardly fail to excite much attention. It was designed by W. G. Walter.

In the whole exposition there are few more interesting exhibits than that made by the navy department on the model battle-ship Illinois. To the electrical man the lighting features possess an especial attraction, but before passing to the consideration of the electrical plant a few words descriptive of this unique piece of naval architecture must be prefaced. The structure is a full sized model above the water line of the Oregon type of battle-ships now building for the United States navy. These vessels have a length on load-water line of 348 feet; extreme breadth, 69¼ feet; displacement, 10,231 tons; maximum indicated horse power, 9,000; estimated sea speed, 15 knots. The main battery consists of four 13-inch rifles, mounted in pairs in turrets forward and aft on the main deck, together with eight eight-inch rifles mounted in pairs in turrets on each side of the superstructure deck, forward and aft, and four six-inch rifles. The secondary battery is efficient, and provision is made for the discharge of torpedoes and for ramming. The ship is protected by heavy armor, ranging from 18 to five inches in thickness.

The Illinois is built in Lake Michigan, opposite Fifty-ninth street, Jackson Park, on a substantial foundation of piling and heavy timbers. The sides of the hull, up to the line of the main deck, are built of brick, and are shaped accurately to the lines of the vessel, and finished inside and outside with a heavy coating of cement. The sides of the superstructure, the redoubts, and the 13-inch and eight-inch barbettes, turrets and guns are constructed of wood framing, covered with cement worked over metal lathing. Other parts are, in most cases, of similar material to that used in the construction of the coast-line battle-ships. Nothing is shown below the berth deck, which rests on the timber framing over pile heads, rendering it impossible to exhibit the boilers and machinery. The berth deck is the exhibit space proper, and on it are to be found the greater part of all the exhibits. All the principal fittings of a modern war vessel are shown in their places, and although many alterations in the plans of the originals have been made (between decks especially), due to the double function of the structure, as an exhibit of itself and to house the exhibit of the navy department, the Illinois is a faithful reproduction, in appearance, of the coast-line battle-ships. An excellent picture of the ship, taken from the most recent photograph, is shown in Fig. 2.

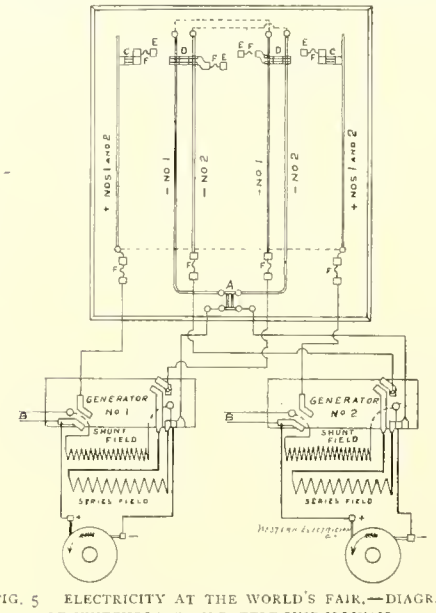

FIG. 5 ELECTRICITY AT THE WORLD'S FAIR.—DIAGRAM OF SWITCHBOARD ON BATTLE-SHIP ILLINOIS.

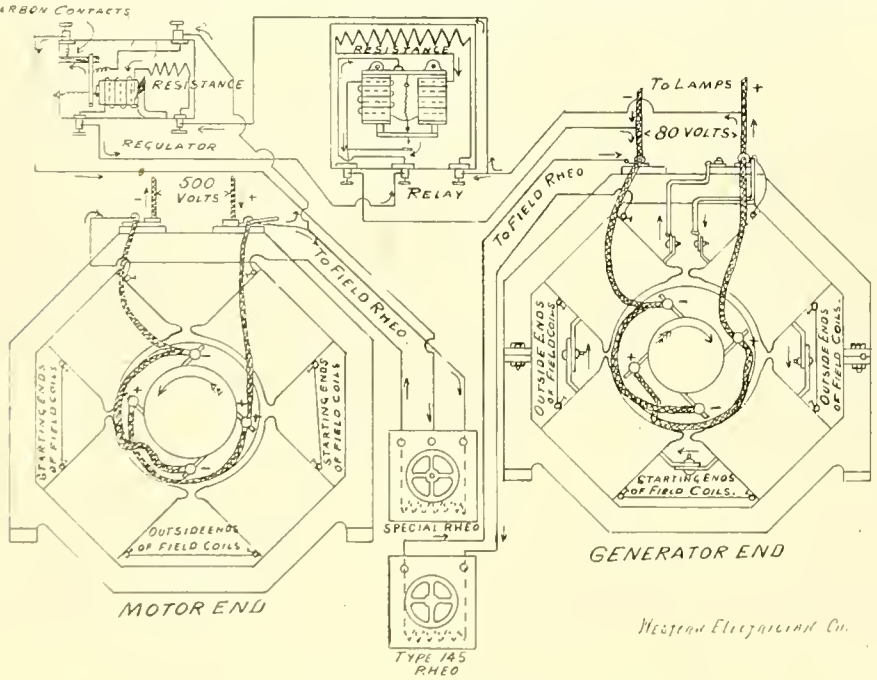

FIG. 4. ELECTRICITY AT THE WORLD'S FAIR.—DIAGRAM OF CONNECTIONS OF THE MOTOR GENERATOR ON THE BATTLE-SHIP ILLINOIS.

The electrical plant is located on the berth deck, a wiring plan of which is shown in Fig. 3, the varying styles of fixtures being indicated by different characters. It provides current for 350 16 candle power incandescent lamps, two 38,000 candle power search-lights and a few motors. In the ships of which the Illinois is a model the plant consists of two 16 kilowatt marine generating sets of the General Electric company's type, the dynamos being multipolar and directly coupled to engines. Two of these sets have been duly installed on the "brick steamship" in the space indicated on the plan, Fig. 3. In the absence of steam on the vessel, however, these engines and dynamos perform no actual service, but are merely shown as exhibits. Occasionally the dynamo of one set is run as a motor to give visitors an idea of its operation. The real work is done by a motor generator, located just forward of the marine sets. This consists of a 500 volt, multipolar, 50 horse power motor, directly coupled to an 80 volt, 32 kilowatt multipolar dynamo, the whole constituting a direct current transformer, by which the 500 volt current taken from the intramural railway circuits at the end of the pier is reduced to a pressure of 80 volts, the regulation navy standard. In order to overcome the fluctuations of current occurring on an electric railroad line it was found necessary to employ a wall controller especially designed for this purpose. This device is operated automatically, and cuts resistance in and out of the shunt winding of the motor. The connections of the motor and generator, with the wall controller, are shown diagrammatically in Fig. 4. All the wiring has been done in strict accordance with the requirements of permanent naval work, and the whole plant, indeed, may be regarded as the most thorough specimen of marine electrical work thus far undertaken at a point so far inland as Chicago. A diagram of the switchboard is shown in Fig. 5. The wiring is on the water-tight system, and all the fixtures are water-tight. In the junction boxes, for instance, the wires pass through rubber glands and the top is secured down on a rubber gasket. A group of the electric fixtures used on the Illinois is illustrated in Fig. 6. Beginning on the left is a signal lantern, next is an officer's desk light, while farther to the right is a round ceiling fixture showing above an Ardois signalling lantern of red and white. Next is a battle lantern, which has a slide, so that the light may be completely hidden during an engagement, when these lanterns would be brought into play in manipulating the guns. Farther on is a bulkhead fixture, with a portable lamp just below it and a deck lantern to the right. The big fixture that comes next contains one of the running lights—the lights placed on the bows of all vessels in navigable waters to indicate, by their color and position, the course of the vessel at night—and in this case being the red or port lantern. The fixture farthest to the right, and the tallest of all, contains a magazine light, by means of which the ammunition magazines are lighted. The rule against admitting fire into the powder magazines is extremely rigorous, and so these rooms are lighted by square fixtures, which are placed in niches in the outer walls of the magazines, the light shining into the rooms through round bull's-eye windows.

There are two search-lights, one on the pilot house, port side, and the other on top of the hammock berthing, superstructure aft, starboard side. A picture of the latter is given in Fig. 7, and, following the plain directions just given, every reader of the WESTERN ELECTRICIAN who visits the ship should be able to find it without further inquiry. Each search-light takes 80 amperes of current at 80 volts pressure, and may be electrically controlled. In the base of each stand is a motor, and the controlling apparatus is placed in some protected part of the ship. In the case of the lamp shown in Fig. 7, however, the switchboard is just abaft the binnacle. The operator can, by means of switches, elevate or lower the projector, turn it to right or left, or it can be set to work automatically, sweeping the horizon in both directions at any arc the operator may desire. These search-lights are operated on every open evening, and attract much attention.

The ship is equipped with a complete set of Ardois electric signaling lanterns, the method of operating which has heretofore been described in this journal. There are five double lanterns (one being shown in Fig. 6), and they are operated by means of a key-board in the pilot-house. The lanterns are suspended by a double jack-stay on the port side of the military mast, extending downward from the upper fighting top at intervals of ten feet. Any ordinary message can be spelled out by the red and white lights.

In addition to the dynamo plant a battery of 100 storage cells, arranged in series of 25 each, is provided. The cells may be discharged in multiple with the generator, or, in case of accident, the lights can be supplied from the batteries alone. Two Sturtevant blowers operated by ¼ horse power General Electric motors are on exhibition in the dynamo and storage battery rooms, and a two horse power motor is used in the machine shop to drive lathes, planers, shapers, etc.

The electrical equipment of the vessel was furnished and installed by the General Electric company, and the work was done under the direction of F. H. Altekamp, foreman of construction in the marine department, and C. C. Mattison, electrical expert. These gentlemen are

always glad to explain the features of the plant to all visitors interested in electricity.

On the occasion of the first visit of the Princess Eulalia to the fair on Thursday of last week an especial effort was made to furnish an attractive electric display in the evening. Among other special features was the word "Eulalia" in letters of fire on the summit of the tower of light in electricity building. Everybody noticed it.

The Hardtmuth carbon exhibit in the electricity building, Fig. 8, is attracting considerable attention. Hardtmuth & Co., of Vienna, evidently appreciate the increasing demand for high-grade carbons in the United States, and have, in connection with their American representative, the International Thomson-Houston company, made a creditable exhibit. Both solid and cored carbons are shown, varying in diameter from 1-8 of an inch to 12 inches. It is said that Hardtmuth & Co. have the largest carbon manufacturing plant in the world, and that they

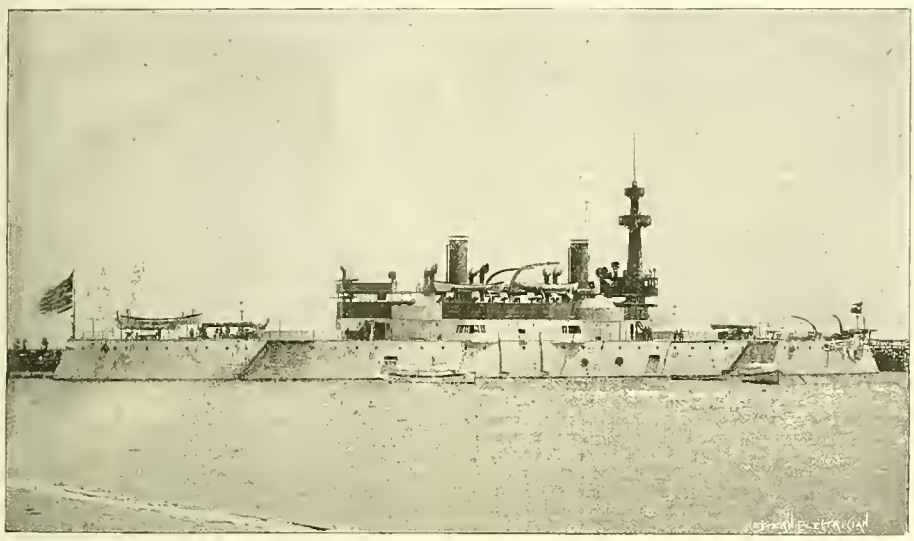

FIG. 2. ELECTRICITY AT THE WORLD'S FAIR —THE BATTLE-SHIP ILLINOIS.

control over two-thirds of the entire business in Europe. Moritz von Hardtmuth is looking after the interests of his company in Chicago. The World's Columbian Exposition has purchased 100,000 of these carbons for use in arc lamps running on incandescent and motor circuits.

Siemens & Halske's electric scenic theater on the Midway Plaisance was opened by a special afternoon performance on Friday of last week.

Two enterprising exhibitors in the northern end of the electricity building—the Elektron Manufacturing company and the Ansonia Electric company—are carrying their friends to the gallery in electric elevators, for which a great multitude rise up and call them blessed.

As in every other department of the exposition, the artistic taste of the French is shown in their exhibit in electricity building. An elaborate incandescent fixture shown by Lacarriere & Delatour of Paris is illustrated in Fig. 9. It is a metallic female figure of life size upholding a cluster of ten lamps in frosted glass globes. The lamps are from the establishment of Pulsford, Triquet & Co. of Paris. Those who are interested in beautiful fixtures of this character should not fail to visit the wonderful collection of bronzes in the French section of the manufactures building, where a number of exquisite designs are shown. The one illustrated, however, may be found in the northwestern bay of the electricity building, ground floor. The French electrical exhibit is in charge of G. De La Touanne, who is glad to explain its features to visitors.

An electric lighting plant is to be established at Montague, Mich.

Storage Battery Controversy at Hartford.

The special committee appointed by the city council of Hartford, Conn., to investigate the working of the storage battery system of street car propulsion as used by the Milford & Hopedale, Mass., Street Railway company, and report upon the advisability of its adoption in Hartford, has concluded its labors. Three reports are presented, one by Prof. Robb, of Trinity College, engaged as an electrical expert, which condemns the system; one by the majority of the committee, recommending its adoption for trial, but providing for the use of the trolley system if the former be found inefficient; and one by the minority, urging the adoption of the Milford system and none other. Prof. Robb's report is, of course, the only one of any scientific value, but he admits that its value is impaired by the refusal of the storage officials to allow him to make any efficiency tests of their batteries. In his report he says his opinion is based upon an inspection of the plant of the company at Milford and upon measurements made with Mr. Rogers, electrician of the Eddy Electric company, of the power required to run the car during the eleven mile run at the time of the committee's visit to Milford on May 1st. Prof. Robb continues:

An inspection of the Milford system shows that under the supervision of Messrs. Usher and Stevens, the Milford & Hopedale company has devised a system of storage battery traction that is in several important particulars a marked improvement upon previous similar systems; the car is under especially good control and runs with very little noise, and the changing of the storage battery from the car to the charging platform is quickly and easily accomplished.

The most important feature of the Milford system, however, is the storage cell invented by Mr. Usher. Unfortunately the officials of the Milford company were unwilling to furnish any of the Usher cells so that their efficiency and life under various conditions could be tested, and conclusions on those points must therefore be based entirely upon the statements of Messrs. Usher and Stevens of the Milford company, and upon statements contained in the affidavit of Prof. Trowbridge of Harvard University, in connection with a suit brought by the Brush Electric company against the Milford & Hopedale Street Railway company. From these statements it appears: First, that the Usher cell does not deteriorate to any marked degree when standing unused. The older forms of cells deteriorate rapidly when not in use. Second, that very much stronger currents can be discharged through the Usher cell than through others without permanently injuring the cells. In running the car on May 1st the current used was frequently greater than 130 amperes, although 20 amperes would have been considered the maximum current that could be sent through the cell of the same size of other types without injuring the cell. Third, that more energy can be stored in an Usher cell of a given size than in the other forms of storage cells. Consequently the Usher cell, assuming the reliability of the above statements, is especially adapted to street railway work. Notwithstanding these advantages of the Milford system over the other storage systems, and recognizing the great advantages of a storage battery system over a trolley system, in that it leaves the streets free from wires and the noise of the trolley, I am of the opinion that the Milford system would not give satisfactory service in the city of Hartford, and that no street railway company could be expected to adopt this system under existing conditions. It was represented to your committee that a car could be run by the storage battery system with less power than by the trolley. In fact that an equipment of two 7½ horse power motors was all that was necessary when the storage battery system was used. The observations made with Mr. Rogers on May 1st during an eleven mile run showed that the average horse power used was 19 6-10 horse power and at times the power used was greater than 50 horse power, the greatest power that can be recorded by the instruments at our disposal. The total power that can be obtained from a storage battery depends upon the rate at which the battery is discharged, and although in the case of the Usher cell it is claimed that the cell is not injured by a rapid rate of discharge, it is admitted that the total power obtained from a given charge diminishes rapidly as the rate of discharge or, what amounts to the same thing, the horse power used is increased. In other words, when power is taken from the storage battery at too rapid a rate, power is wasted; the loss of the power in the trolley system due to the electrical resistance of the wire and to leakage owing to imperfect insulation is inappreciable in comparison with the loss of power due to the low efficiency of a storage battery when the power is used at the rate necessary in running the cars of a street railway. In going up the heavy grades between Milford and Hopedale, the power required to run the car was greater than the greatest horse power that our instruments would measure; that is, greater than 50 horse power. This power was required on a day when it was not raining and with only nine passengers in the car and no stops were made on the grade. I would infer from this that with a loaded car and with the tracks wet and slippery, the power furnished by the battery on the car would be entirely insufficient at least to maintain rapid transit on the heavier grades of our city railway. To carry a larger battery would be impracticable. One of the chief claims of the Milford company is that the compactness and lightness of its battery equipment makes the system a practical one from a commercial standpoint.

Up to the present time the Milford system has been tried only upon a street railway where the cars are run at infrequent intervals, with light loads and under the direct supervision of the inventors of the system; before adopting the system it would be essential to have a thorough test made under local conditions of street railway service and with the entire equipment of the car, including the battery open to inspection.

The Brush Electric company holds a broad patent on storage cells where the active material is mechanically applied and it has brought suit for an injunction against the Milford & Hopedale Street Railway company, claiming that the Usher cell is an infringement of the Brush patent. Until this suit is settled no street railway would be likely to adopt the system, even if it were satisfactory in other respects.

The report of the majority of the committee is as follows:

We have, in connection with Prof. Robb and Mr. Rogers of the Eddy Electric company of Windsor, given the matter most careful consideration. We find that the practical workings of the system are apparently satisfactory. The road at Milford comprises about six and one-half miles of track, in course of which there were many grades and many sharp curves. The steepest grade was one of 10 per cent. This grade was ascended at the rate of six miles an hour. The greatest rate of speed shown was from 18 to 20 miles per hour, at which rate the car was stopped within 60 feet. A distance of two and one-half miles was covered in 11 minutes, and the same time was made on the return trip. The cars run very smoothly, with comparatively no jolting, and conversation while in transit can be easily heard. The road bed is constructed with comparatively light rails, and sleepers or ties six to eight feet apart. The car equipment consists of duplicate batteries containing 140 cells and two motors estimated at seven and one-half horse power each, the total weight of the car fully equipped being seven and one-half tons. The batteries are charged in the power house, and it was stated by Mr. Usher, the president of the system, that two and three-fourth hours' of charging was sufficient for a 35-mile run. These batteries are placed on a platform during the process of charging and from this are easily slid into the cars. They can be replaced in about two minutes. From a commercial standpoint we find, as compared with the trolley system:

First, that at the power house each system requires boilers, engines and dynamos, but that the amount of horse power required by the storage battery system is stated to be 50 per cent. less than that required by the trolley.

Second, that in the storage system the wires and poles are dispensed with, which is a great item of expense. For

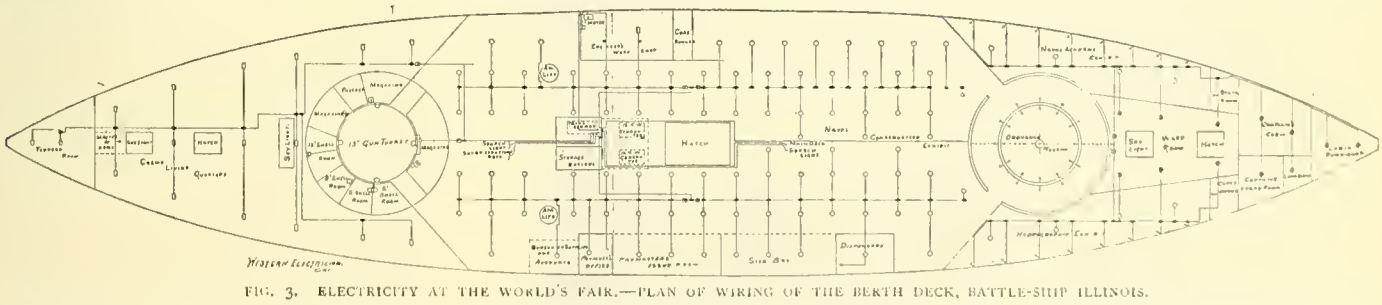

FIG. 3. ELECTRICITY AT THE WORLD'S FAIR.—PLAN OF WIRING OF THE BERTH DECK, BATTLE-SHIP ILLINOIS.

instance, in the Springfield system the cost for wiring and poling in round numbers was about $4,000 a mile. This amount includes feed wires.

Having now reached a point where the comparative expense of both systems is to be shown, we submit the following:

Hartford has about 30 miles of road in operation. Figuring for wiring and poling on the same basis used by the Springfield system, that is at the rate of $4,000 per mile, we have $120,000 for wiring and poling the entire road. It, as is claimed, the Hartford & Weathersfield Horse Railroad company runs 40 cars, the cost of equipping the same with duplicate sets of batteries at $2,200 per car would be $88,000, which would be $32,000 less than equipping the same line with the trolley system.

In comparing the two systems we have taken the city of Springfield, which is conceded by expert electricians to have one of the best constructed systems in the United States. Furthermore, our figures are more accurate than those that can be obtained from statistics as they come di-

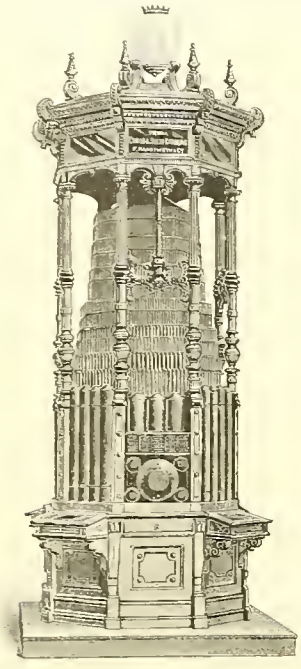

FIG. 8. ELECTRICITY AT THE WORLD'S FAIR.—HARDTMUTH'S CARBON EXHIBIT, ELECTRICITY BUILDING.

rectly from the management of each system. Now as to the cost of propulsion in the trolley system as compared with the maintenance of the storage system, we find that in the Springfield road the power is furnished by the Springfield Electric Light company at a cost of 3 cents a mile per car which it claims is less than in most cities and even cheaper than the management of the trolley road can furnish power itself, for the reason that it furnishes the power for lighting the city, and hence has surplus power at its disposal, which it can afford to sell at a very low rate. Admitting that this rate is low, it will be seen that the cost of power per car estimated at running 100 miles per day would be $3 per car. The maintenance of the storage system will be guaranteed at $800 per car per year or $2.19 per day. With such a guaranty it will be seen that the element of loss to the company for the deterioration of batteries is removed. It is conceded by electricians in general that the traction car of the future is the storage battery car.

Concerning the suit for alleged infringement of patents by the Brush Electric company, we are informed that the Milford & Hopedale company is willing to give bonds guaranteeing the Hartford road against any loss or losses from patent litigation. In view of the foregoing facts we feel justified in requesting and authorizing the Hartford & Weathersfield Horse Railroad company to equip one of its main lines with the Milford storage battery system.

Light and Other High Frequency Phenomena.

By Nikola Tesla.

PART III.

The first class of effects I intend to show you are effects produced by electrostatic force. It is the force which governs the motion of the atoms, which causes them to collide and develop the life sustaining energy of heat and light, and which causes them to aggregate in an infinite variety of ways, according to Nature's fanciful designs, and to form all these wondrous structures we perceive around us; it is, in fact, if our present views be true, the most important force for us to consider in Nature. As the term electrostatic might imply a steady electric condition, it should be remarked that in these experiments the force is not constant, but varies at a rate which may be considered moderate, about one million times a second, or thereabouts. This enables me to produce many effects which are not producible with an unvarying force.

When two conducting bodies are insulated and electrified, we say that an electrostatic force is acting between them. This force manifests itself in attractions, repulsions and stresses in the bodies and space or medium without. So great may be the strain exerted in the air, or whatever separates the two conducting bodies, that it may break down, and we observe sparks or bundles of light or streamers, as they are called. These streamers form abundantly when the force through the air is rapidly varying. I will illustrate this action of electrostatic force in a novel experiment in which I will employ the induction coil before referred to. The coil is contained in a trough filled with oil, and placed under the table. The two ends of the secondary wire pass through the two thick columns of hard rubber, which protrude to some height above the table. It is necessary to insulate the ends or terminals of the secondary heavily with hard rubber, because even dry wood is by far too poor an insulator for these currents of enormous potential differences. On one of the terminals of the coil I have placed a large sphere of sheet brass, which is connected to a larger insulated brass plate, in order to enable me to perform the experiments under conditions which, as you will see, are more suitable for this experiment. I now set the coil to work and approach the free terminal with a metallic object held in my hand, this simply to avoid burns. As I approach the metallic object to a distance of eight or ten inches, a torrent of furious sparks break forth from the end of the secondary wire, which passes through the rubber column. The sparks cease when the metal in my hand touches the wire. My arm is now traversed by a powerful electric current, vibrating at about the rate of one million times a second. All around me the electrostatic force makes itself felt, and the air molecules and particles of dust flying about are acted upon and are hammering violently against my body. So great is this agitation of the particles, that when the lights are turned out you may see streams of feeble light appear on some parts of my body. When such a streamer breaks out on any part of the body, it produces a sensation like the pricking of a needle. Were the potentials sufficiently high and the frequency of the vibration rather low, the skin would probably be ruptured under the tremendous strain, and the blood would rush out with great force in the form of fine spray or jet so thin as to be invisible, just as oil will when placed on the positive terminal of a Holtz machine. This breaking through of the skin, though it may seem impossible at first, would perhaps occur, by reason of the tissues under the skin being incomparably better conducting. This, at least, appears plausible, judging from some observations.

I can make these streams of light visible to all, by touching with the metallic object one of the terminals as before, and approaching my free hand to the brass sphere, which is connected to the second terminal of the coil. As the hand is approached the air between it and the sphere, or in the immediate neighborhood, is more violently agitated and you see streams of light now break forth from my finger tips and from the whole hand, Fig. 5. Were I to approach the hand closer, powerful sparks would jump from the brass sphere to my hand, which might be injurious. The streamers offer no particular inconvenience, except that in the ends of the finger tips a burning sensation is felt. They should not be confounded with those produced by an influence machine because in many respects they behave differently. I have attached the brass sphere and plate to one of the terminals in order to prevent the formation of visible streamers on that terminal, also in order to prevent sparks from jumping at a considerable distance. Besides, the attachment is favorable for the working of the coil.

The streams of light which you have observed issuing from my hand are due to a potential of about 200,000 volts, alternating in rather irregular intervals, something like a million times a second. A vibration of the same amplitude, but four times as fast, to maintain which over 3,000,000 volts would be required, would be more than sufficient to envelop my body in a complete sheet of flame. But this

FIG. 9. ELECTRICITY AT THE WORLD'S FAIR —FRENCH INCANDESCENT LIGHT FIXTURE, ELECTRICITY BUILDING.

flame would not burn me up; quite contrarily, the probability is that I would not be injured in the least. Yet a hundredth part of that energy, otherwise directed, would be amply sufficient to kill a person.

The amount of energy which may thus be passed into the body of a person depends on the frequency and potential of the currents, and by making both of these very great, a vast amount of energy may be passed into the body without causing any discomfort, except perhaps, in the arm which is traversed by a true conduction current. The reason why no pain in the body is felt and no injurious effect noted is that everywhere, if a current be imagined to flow through the body, the direction of its flow would be at right angles to the surface; hence the body of the experimenter offers an enormous section to the current, and the density is very small, with the exception of the arm perhaps, where the density may be considerable. But if only a small fraction of that energy would be applied in such a way that a current would traverse the body in the same manner as a low frequency current, a shock would be received which might be fatal. A direct or low frequency alternating current is fatal, I think, principally because its distribution through the body is not uniform, as it must divide itself in minute streamlets of great density, whereby some organs are vitally injured. That such a process occurs I have not the least doubt, though no evidence might apparently exist or be found upon examination. The surest to injure and destroy life is a continuous current, but the most painful is an alternating current of very low frequency. The expression of these views, which are the result of long continued experiment and observation, both with steady and varying currents, is elicited by the interest which is at present taken in this subject, and by the manifestly erroneous ideas which are daily propounded in journals on this subject.

I may illustrate an effect of the electrostatic force by another striking experiment, but before doing so I must call your attention to one or two facts. I have said that when the medium between two oppositely electrified bodies is strained beyond a certain limit it gives way and, stated in popular language, the opposite electric charges unite and neutralize each other. This breaking down of the medium occurs principally when the force acting between the bodies is steady, or varies at a moderate rate. Were the variation sufficiently rapid, such a destructive break would not occur, no matter how great the force, for all the energy would be spent in radiation, convection and

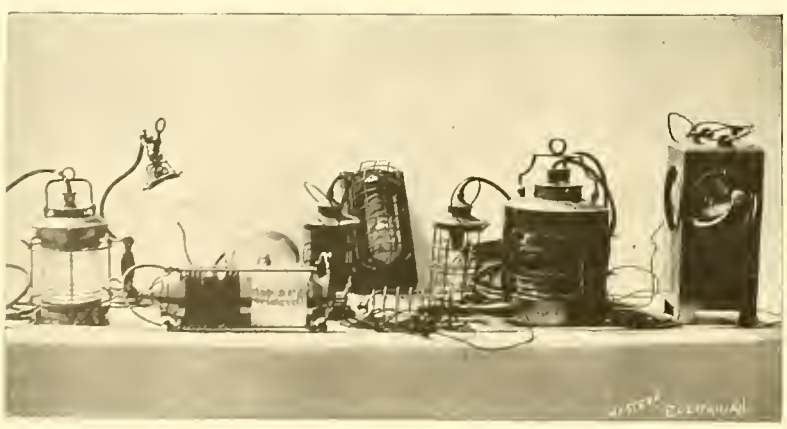

FIG. 6. ELECTRICITY AT THE WORLD'S FAIR.—SOME OF THE ELECTRICAL FIXTURES USED ON THE BATTLE-SHIP ILLINOIS.

mechanical and chemical action. Thus the spark length or greatest distance through which a spark will jump between the electrified bodies o is the smaller, the greater the variation or time rate of change. But this rule may be taken to be true only in a general way, when comparing rates which are widely different.

I will show you by an experiment the difference in the effect produced by a rapidly varying and a steady or moderately varying force. I have here two large circular brass plates $p\,p$, Fig. 6*a* and Fig. 6*b*, supported on movable insulating stands on the table, connected to the ends of the secondary of a similar coil as the one used before. I place the plates ten or twelve inches apart and set the coil to work. You see the whole space between the plates, nearly two cubic feet, filled with uniform light, Fig 6*a*. This light is due to the streamers you have seen in the first experiment, which are now much more intense. I have already pointed out the importance of these streamers in commercial apparatus and their still greater importance in some purely scientific investigations. Often they are too weak to be visible, but they always exist, consuming energy and modifying the action of the apparatus. When intense, as they are at present, they produce ozone in great quantity and also, as Professor Crookes has pointed out, nitrous acid. So quick is the chemical action, that if a coil, such as this one, is worked for a very long time it will make the atmosphere of a small room unbearable, for the eyes and throat are attacked. But when moderately produced, the streamers refresh the atmosphere wonderfully, like a thunder-storm, and exercise unquestionably a beneficial effect.

In this experiment the force acting between the plates changes in intensity and direction at a very rapid rate. I will now make the rate of change per unit time much smaller. This I effect by rendering the discharges through the primary of the induction coil less frequent, and also by diminishing the rapidity of the vibration in the secondary. The former result is conveniently secured by lowering the electromotive force over the air gap in the primary circuit, the latter by approaching the two brass plates to a distance of about three or four inches. When the coil is set to work you see no streamers or light between the plates, yet the medium between them is under a tremendous strain. I still further augment the strain by raising the electromotive force in the primary circuit, and soon you see the air give way and the hall is illuminated by a shower of brilliant and noisy sparks, 6*b*. These sparks could be produced also with unvarying force; they have been for many years a familiar phenomenon, though they were usually obtained from entirely different apparatus. In describing these two phenomena, so radically different in appearance, I have advisedly spoken of a "force" acting between the plates. It would be in accordance with accepted views to say that there was an "alternating electromotive force" acting between the plates. This term is quite proper and applicable in all cases where there is evidence of at least a possibility of an essential inter-dependence of the electric state of the plates or electric action in their neighborhood. But if the plates were removed to an infinite distance, or if at a finite distance, there is no probability or necessity whatever for such dependence. I prefer to use the term "electrostatic force," and to say that such a force is acting around each plate or electrified insulated body in general. There is an inconvenience in using this expression, as the term incidentally means a steady electric condition; but a proper nomenclature will eventually settle this difficulty.

I now return to the experiment to which I have already alluded, and with which I desire to illustrate a striking effect produced by a rapidly varying electrostatic force. I attach to the end of the wire, L, Fig. 7, which is in connection with one of the terminals of the secondary of the induction coil, an exhausted bulb b. This bulb contains a thin carbon filament F, which is fastened to a platinum wire w, sealed in the glass and leading outside of the bulb, where it connects to the wire L. The bulb may be exhausted to any degree attainable with ordinary apparatus. Just a moment before, you have witnessed the breaking down of the air between the charged brass plates. You know that a plate of glass, or any other insulating material would break down in like manner. Had I therefore a metallic coating attached to the outside of the bulb, or placed near the same, and were this coating connected to the other terminal of the coil, you would be prepared to see the glass give way if the strain were sufficiently increased. Even were the coating not connected to the other terminal, but to an insulated plate, still, if you have followed recent developments, you would naturally expect a rupture of the glass.

But it will certainly surprise you to note that under the action of the varying electrostatic force, the glass gives way when all other bodies are removed from the bulb. In fact, all the surrounding bodies we perceive might be removed to an infinite distance without affecting the result in the slightest. When the coil is set to work, the glass is invariably broken through at the seal, or other narrow channel, and the vacuum is quickly impaired. Such a damaging break would not occur with a steady force, even if the same were many times greater. The break is due to the agitation of the molecules of the gas within the bulb and outside of the same. This agitation, which is generally most violent in the narrow pointed channel near the seal, causes a heating and rupture of the glass. This rupture would, however, not occur, not even with a varying force, if the medium filling the inside of the bulb and that surrounding it were perfectly homogeneous. The break occurs much quicker if the top of the bulb is drawn out into a fine fiber. In bulbs used with these coils such narrow, pointed channels must therefore be avoided.

When a conducting body is immersed in air or similar insulating medium consisting of or containing small freely movable particles capable of being electrified, and when the electrification of the body is made to undergo a very rapid change—which is equivalent to saying that the electrostatic force acting around the body is varying in intensity—the small particles are attracted and repelled, and their violent impacts against the body may cause a mechanical motion of the latter. Phenomena of this kind are noteworthy, inasmuch as they have not been observed before with apparatus such as has been commonly in use. If a very light conducting sphere be suspended on an exceedingly fine wire, and charged to a steady potential, however high, the sphere will remain at rest. Even if the potential would be rapidly varying, provided that the small particles of matter, molecules or atoms, are evenly distributed, no motion of the sphere should result. But if one side of the conducting sphere is covered with a thick insulating layer, the impacts of the particles will cause the sphere to move about, generally in irregular curves, Fig. 8*a*. In like manner, as I have shown on a previous occasion, a fan of metal sheet, Fig. 8*b*, covered partially with insulating material, as indicated, and placed upon the terminal of the coil so as to turn freely in it, is spun around.

All these phenomena you have witnessed and others which will be shown later are due to the presence of a medium like air, and would not occur in a continuous medium. The action of the air may be illustrated still better by the following experiment. I take a glass tube t, Fig. 9 of about an inch in diameter, which has a platinum wire w sealed in the lower end, and to which is attached a thin lamp filament f. I connect the wire with the terminal of the coil and set the coil to work. The platinum wire is now electrified positively and negatively in rapid succession, and the wire and air inside of the tube are rapidly heated by the impacts of the particles, which may be so violent as to render the filament incandescent. But if I pour oil in the tube, just as soon as the wire is covered with the oil, all action apparently ceases, and there is no marked evidence of heating. The reason of this is that the oil is a practically continuous medium. The displacements in such a continuous medium are, with these frequencies, to all appearance incomparably smaller than in air; hence the work performed in such a medium is insignificant. But oil would behave very differently with frequencies many times as great, for even though the displacements be small, if the frequency were much greater, considerable work might be performed in the oil.

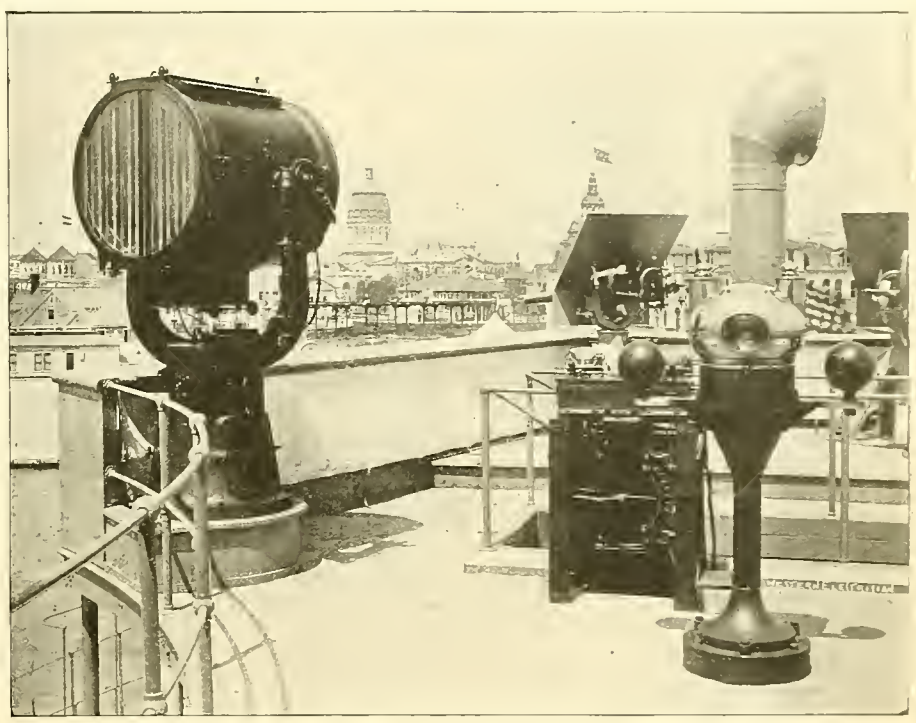

FIG. 7 ELECTRICITY AT THE WORLD'S FAIR.—SEARCH-LIGHT ON THE BATTLE-SHIP ILLINOIS.

The electrostatic attractions and repulsions between bodies of measurable dimensions are, of all the manifestations of this force, the first so-called electrical phenomena noted. But though they have been known to us for many centuries, the precise nature of the mechanism concerned in these actions is still unknown to us, and has not been even quite satisfactorily explained. What kind of mechanism must that be? We cannot help wondering when we observe two magnets attracting and repelling each other with a force of hundreds of pounds with apparently nothing between them. We have in our commercial dynamos magnets capable of sustaining in mid-air tons of weight. But what are even these forces acting between magnets when compared with the tremendous attractions and repulsions produced by electrostatic force, to which there is apparently no limit as to intensity. In lightning discharges bodies are often charged to so high a potential that they are thrown away with inconceivable force and torn asunder or shattered into fragments. Still even such effects cannot compare with the attractions and repulsions which exist between charged molecules or atoms, and which are sufficient to project them with speeds of many kilometers a second so that under their violent impact bodies are rendered highly incandescent and are volatilized. It is of special interest for the thinker who inquires into the nature of these forces to note that whereas the actions between individual molecules or atoms occur seemingly under any condition, bearing upon the preceding remarks, namely, when the filament had been kept incandescent some time the narrow tube and the space inside was brought to an elevated temperature, and as the gas in the tube then became conducting the electrostatic attraction between the glass and the filament became very weak or ceased, and the filament came to rest. When it came to rest it would glow far more intensely. This was probably due to its assuming the position in the center of the tube where the molecular bombardment was most intense, and also partly to the fact that the individual impacts were more violent and that no part of the supplied energy was converted into mechanical movement. Since, in accordance with accepted views, in this experiment the incandescence must be attributed to the impacts of the particles, molecules or atoms in the heated space, these particles must, therefore, in order to explain such action, be assumed to behave as independent carriers of electric charges immersed in an insulating medium, yet there is no attractive force between the glass tube and the filament because the space in the tube is, as a whole, conducting.

It is of some interest to observe in this connection that whereas the attraction between two electrified bodies may cease, owing to the impairing of the insulating power of the medium in which they are immersed, the repulsion between the bodies may still be observed. This may be explained in a plausible way. When the bodies are placed at some distance in a poorly conducting medium, such as slightly warmed or rarefied air, and are suddenly electrified, opposite electric charges being imparted to them, these charges equalize more or less by leakage through the air. But if the bodies are similarly electrified, there is less opportunity afforded for such dissipation, hence the repulsion observed in such case is greater than the attraction. Repulsive actions in a gaseous medium are, however, as Prof. Crookes has shown, enhanced by molecular bombardment.

(*Continued on page 315*)

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VISITORS

To the World's Fair are requested to forward their addresses to the WESTERN ELECTRICIAN as early as possible or notify us immediately upon their arrival in Chicago.

SOMETHING must be the matter with the liver of the editor of our able contemporary, the London *Electrician*, for he certainly views the World's Fair with a jaundiced eye. He alludes to it as "an archipelago of packing cases encircled in a sea of mud" and is quite disgusted with the fuss made over it and the superlative ecstacies indulged in by some of our American writers in their vain endeavors to write up to the height of the occasion". We must admit that criticism of some of the grandiose, adjective-studded descriptions of the World's Fair that have been published is well deserved on the score of good taste, although the extent and magnificence of the exposition are such that it is not strange that many writers become somewhat giddy in attempting to reach the heights to which our contemporary refers. But to employ the "packing-case and mud" metaphor is going to the other extreme, and can best be accounted for as the effect of a disordered digestion. A radical cure could be wrought by a sea voyage and a land journey to Chicago, and this we hope to see accomplished, but in the meantime the weekly treatment afforded by the columns of the WESTERN ELECTRICIAN may be accepted as an excellent substitute and palliative.

TWO accidents have occurred in Chicago since the introduction of the overhead trolley on the cross-town lines of the South Side, but neither of these was directly attributable to the fact that electric power was used. As a matter of fact it is to be expected that until the people grow accustomed to the new swift-going cars that have replaced the slow-going horse cars, there will be increased danger of accidents. But the same would be true of any other form of power used. Rapid transit cannot be had except by the utilization of modern methods of propulsion and all of these involve increased danger to life and limb. Certain it is that with these improvements the companies should exercise greater care in the selection of employes in whose charge the cars are placed and they should not be put on duty until they have been thoroughly instructed in the handling of the apparatus. There is much responsibility on the company and its employes and there are corresponding obligations resting on the public. Generally speaking the accidents on electric railways are caused by negligence or ignorance on the part of the victims, but the public is not discriminating and it does not always give corporations credit for what they have done. A little patience on the part of the public and the exercise of reasonable precaution by the company will avert accidents and promote good feeling.

SO MUCH has been said about the success of the Milford and Hopedale storage battery railway in Massachusetts that the official reports of Hartford citizens appointed to investigate the system, which are presented on another page, will be read with great interest. A local street car company in the Connecticut capital proposes to abandon horses and employ electricity as a motive power, and before the desired corporate permission was given a committee of citizens was appointed to carefully examine the practical working of the storage battery line at Milford, with the idea of securing the best possible system for the city before making the final decision. Prof. Robb of Trinity College was secured to accompany the committee in the capacity of an electrical expert.

The citizens have now made their reports, and it is not surprising that a considerable diversity of opinion exists. All the gentlemen were disinterested, and all entered upon the investigation with the hope that they could conscientiously report in favor of the storage battery as a practical, commercial factor in street railway work. Nevertheless, the only one of the party trained in the study of electrical problems felt compelled to report adversely on the system, the majority of the committee recommended the new system in guarded terms, but insisted that the Hartford company should also equip its line for the trolley system to be prepared for a failure of the batteries, while only a minority of the committee declared unreservedly in favor of the employment of accumulators.

On the whole, the result of the investigation made for the benefit of Hartford must be regarded as unfavorable to the storage battery system despite the rose-colored reports of the achievements at Milford, which have from time to time been published in the daily press. The opinion of Prof. Robb will carry much weight, especially in view of the fact that the management of the Milford and Hopedale company denied him the privilege of making a careful series of tests of the storage cell employed, for the purpose of determining its efficiency and durability. This refusal on the part of the company will certainly be taken as an admission of weakness by the general public. The professor also doubts whether it is practicable to carry enough energy on a car to propel it, heavily loaded, up a stiff grade in rainy or winter weather—conditions which, of course, must be anticipated. He also wisely points out the present condition of the litigation over storage battery patents, and warns the public of the danger of interference on this score. Many of the members of the committee seem greatly taken by the smaller initial cost of the storage battery system by reason of the absence of poles and wires. Insufficient attention, however, appears to have been paid to the comparative charges for maintenance and renewals of the two systems, and the fact that the earning power of the trolley roads is greatly increased by the ability to attach trailers to the motor cars, which does not seem to be possible with storage battery propulsion, appears to have been entirely lost sight of. The figures presented in the report are far from convincing us that the storage battery system is the more economical of the two, when relative earning power is taken into consideration.

Everybody would hail the introduction of a practical, every-day, rough-and-ready storage battery system for the propulsion of street cars with joy. How delightful to spin along in rapid-going cars actuated by a hidden source of energy, self-contained, with no smoke or cinders, laboring animals or landscape-disfiguring poles and wires! Rapid transit would then become ideal, and the New York newspaper men would be forced to abandon their "deadly trolley" cry and seek some other bugaboo to alarm the public. It is a pleasing prospect, but we fear that we have advanced but little toward it as the result of the first disinterested public investigation of the line at Milford.

GOVERNOR FLOWER'S plan for equipping the Erie canal with an overhead trolley system is attracting as much attention among capitalists and engineers as the men directly interested in the great waterway through the Empire State. It is evident that the governor has given the subject much thought. He has secured the opinions of experienced engineers on the feasibility of the project. In a recent interview he said he had procured estimates of the cost of such an equipment, and he felt sure that it would be covered by $1 000,000. This, he says, would provide for twelve power houses thirty miles apart. He believes that there are ample water powers along the canal to operate the plants, and that current could be supplied cheaply to the boatmen, thus greatly improving the system. Better time could be made by the boats, and this fact alone would, in his opinion, warrant the expenditure of a large sum of money. At the present time the state is called upon to expend over half a million dollars annually in keeping the towpath in repair. The introduction of the trolley system would remove the necessity for this expenditure, and the money could be used for deepening the channel and strengthening the banks to provide against washouts.

At the present time the only serious objection that can be raised to the adoption of the trolley system is the fact that there is not a uniform depth throughout the entire course, and that there is not in some parts of the canal enough water to allow the use of propellors. This, however, could be easily remedied, and the advantages, it would seem, would justify the Legislature in making the necessary appropriation. In this connection Governor Flower calls attention to the fact that Canada is spending $50,000,000 in improving the Welland canal and the St. Lawrence, in order to get a sufficient depth of water to allow of the establishing of a line of steamboats between Chicago, Duluth and Montreal. These steamers will each have a carrying capacity of over 2,000 tons, and could carry grain at five cents a bushel. This leads the governor to remark that "if New York is not to lose her supremacy as a port the national government should deepen the Buffalo harbor to twenty feet. This would enable vessels to come down the lakes to Buffalo, carrying a thousand more tons of grain than the Canadians propose to do with their steamers. If something of this sort is not done, and if we do not increase the speed of our canal boats, the great bulk of the western grain trade will go to the St. Lawrence. The canal has made the Empire State, and the people should not be slow in recognizing that fact and in bending every nerve toward increasing its efficiency."

While it is quite probable that the state will be called upon to make the necessary appropriation, there is no reason why private capital should not be used for this purpose if the Legislature refuses to undertake the work. In fact there are many reasons why it would be better to enlist private capital. In the first place the work would probably be conducted much more expeditiously and economically if removed from political influences. This fact is recognized by Governor Flower, who is quoted as saying: "If it does not seem best for the state to appropriate any such large sum of money as $1,000,000 for the purpose of equipping the Erie canal with an electric system, it strikes me that it would be an excellent opportunity for some private corporation, for not only could such a corporation furnish power for canal transportation, but it could as well do the lighting for the many little towns and cities along the route of the canal. It seems to me as a business man that this is an excellent opportunity for somebody to make some money."

It is a matter of congratulation that so much interest is manifested in this subject by Governor Flower, and it is to be hoped that the investigation instituted under his direction will result in the development of a practicable system of improved canal propulsion. It is certainly an important project, and if brought to a successful completion will be one of the most noteworthy accomplishments of the present administration

Light and other High Frequency Phenomena.

(*Continued from page* 313).

So far, I have considered principally effects produced by a varying electrostatic force in an insulating medium, such as air. When such a force is acting upon a conducting body of measurable dimensions, it causes within the same, or on its surface, displacements of the electricity and gives rise to electric currents, and these produce another kind of phenomena, some of which I shall presently endeavor to illustrate. In presenting this second class of electrical effects, I will avail myself principally of such as are producible without any return circuit, hoping to interest you

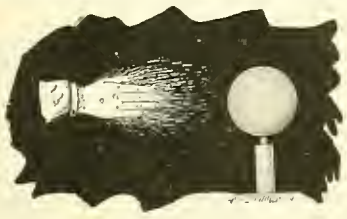
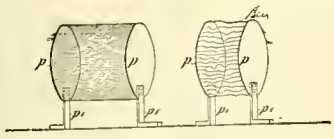


FIG. 5. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA. —EFFECT OF VARYING ELECTROSTATIC FORCE WITH A TRANSFORMER OF 200,000 VOLTS PRESSURE.

the more by presenting these phenomena in a more or less novel aspect.

It has been for a long time customary, owing to the limited experience with vibratory currents, to consider an electric current as something circulating in a closed conducting path. It was astonishing at first to realize that a current may flow through the conducting path even if the latter be interrupted, and it was still more surprising to learn, that sometimes it may be even easier to make a current flow under such conditions than through a closed path. But that old idea is gradually disappearing, even among practical men, and will soon be entirely forgotten.

If I connect an insulated metal plate P, Fig. 11, to one of the terminals T of the induction coil by means of a wire, though this plate be very well insulated, a current passes through the wire when the coil is set to work. First I wish to give you evidence that there is a current passing through the connecting wire. An obvious way of demonstrating this is to insert between the terminal of the coil and the insulated plate a very thin platinum or german silver wire w and



FIGS. 6*a* AND 6*b*. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—EFFECTS OF RAPIDLY VARYING AND STEADY ELECTROSTATIC FORCE.

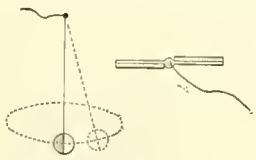
bring the latter to incandescence or fusion by the current. This requires a rather large plate or else current impulses of very high potential and frequency. Another way is to take a coil C, Fig. 11, containing many turns of thin insulated wire and to insert the same in the path of the current to the plate. When I connect one of the ends of the coil to the wire leading to another insulated plate P, and its other end to the terminal T, of the induction coil, and set the latter to work, a current passes through the inserted coil c and the existence of the current may be made manifest in various ways For instance, I insert an iron core i within the coil. The current being one of very high frequency, if it be of some strength, will soon bring the iron core to a noticeably higher temperature, as the hysteresis and current losses are great with such high frequencies. One might take a core of some size, laminated or not, it would matter little; but ordinary iron wire 1-16 or 1-8 of an inch thick is suitable for the purpose. While the induction coil is working a current traverses the inserted coil and only a few moments are sufficient to bring the iron wire i to an elevated temperature sufficient to soften the sealing-wax s, and cause a paper washer p fastened by it

FIG. 7. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA. —BREAKING A BULB ON OPEN CIRCUIT.

to the iron wire to fall off. But with the apparatus such as I have here, other, much more interesting, demonstrations of this kind can be made. I have a secondary S, Fig. 12, of coarse wire, wound upon a coil similar to the first. In the preceding experiment the current through the coil c, Fig. 11, was very small, but there being many turns a strong heating effect was, nevertheless, produced in the iron wire. Had I passed that current through a conductor in order to show the heating of the latter, the current might have been too small to produce the effect desired. But with this coil provided with a secondary winding, I can now transform the feeble current of high tension which passes through the primary P into a strong secondary current of low tension, and this current will quite certainly do what I expect. In a small glass tube (t, Fig. 12) I have enclosed a coiled platinum wire, w, this merely in order to protect the wire. On each end of the glass tube is sealed a terminal of stout wire to which one of the ends of the platinum wire w, is connected. I join the terminals of the secondary coil to these terminals and insert the primary p, between the insulated plate P_1 and the terminal T_1 of the induction coil as before. The latter being set to work, instantly the platinum wire w is rendered incandescent and can be fused even if it be very thick.

Instead of the platinum wire I now take an ordinary 50-volt 16 candle power lamp. When I set the induction coil in operation the lamp filament is brought to high incandescence. It is, however, not necessary to use the insulated plate, for the lamp l, Fig. 13, is rendered incandescent even if the plate P_1 be disconnected. The secondary may also be connected to the primary as indicated by the dotted line in Fig. 13, to do away, more or less, with the electrostatic induction or to modify the action otherwise.

I may here call attention to a number of interesting observations with the lamp. First, I disconnect one of the terminals of the lamp from the secondary S When the induction coil plays, a glow is noted which fills the whole bulb. This glow is due to electrostatic induction. It in-



FIGS. 8*a* AND 8*b*. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—MECHANICAL MOTIONS PRODUCED BY VARYING ELECTROSTATIC FORCE IN A GASEOUS MEDIUM.

creases when the bulb is grasped with the hand, and the capacity of the experimenter's body thus added to the secondary circuit. The secondary, in effect, is equivalent to a metallic coating, which would be placed near the primary. If the secondary or its equivalent, the coating, were placed symmetrically to the primary, the electrostatic induction would be nil under ordinary conditions—that is, when a primary return circuit is used, as both halves would neutralize each other. The secondary is, in fact, placed symmetrically to the primary, but the action of both halves of the latter, when only one of its ends is connected to the induction coil, is not exactly equal; hence electrostatic induction takes place, and hence the glow in the bulb. I can nearly equalize the action of both halves of the primary by connecting the other, free end of the same to the insulated plate, as in the preceding experiment. When the plate is connected the glow disappears. With a smaller plate it would not entirely disappear, and then it would contribute to the brightness of the filament

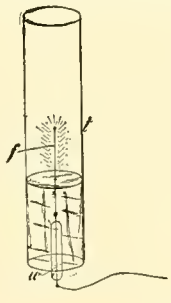


FIG. 9. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA. —SHOWING THE EFFECT OF THE AIR.

when the secondary is closed, by warming the air in the bulb.

To demonstrate another interesting feature, I have adjusted the coils used in a certain way. I first connect both the terminals of the lamp to the secondary, one end of the primary being connected to the terminal T_1 of the introduction coil and the other to the insulated plate P_1 as before. When the current is turned on, the lamp glows brightly, as shown in Fig. 14*b*, in which C is a fine wire coil and S a coarse wire secondary wound upon it. If the insulated plate P_1 is disconnected, leaving one of the ends a of the primary insulated, the filament becomes dark or generally it diminishes in brightness, Fig. 14*a*. Connecting again the plate P_1 and raising the frequency of the current I make the filament quite dark or barely red, Fig. 15*b*. Once more I will disconnect the plate. One will of course infer that when the plate is disconnected, the current through the primary will be weakened, that therefore the electromotive force will fall in the secondary S, and that the brightness of the lamp will diminish. This might be the case and the result can be secured by an easy adjustment of the coils; also by varying the frequency and potential of the currents. But it is perhaps of greater interest to note that the lamp increases in brightness when the plate is disconnected, Fig. 15*a*. In this case all the energy the primary receives is now sunk into it, like the charge of a battery in an ocean cable, but most of that energy is recovered through the secondary and used to light the lamp. The current traversing the primary is strongest at the end b, which is connected to the terminal T_1 of the induction coil, and diminishes in strength towards the remote end a. But the dynamic inductive effect exerted upon the secondary S is now greater than before when the suspended plate was connected to the primary. These results might have been produced by a number of causes. For instance, the plate P_1 being connected, the reaction from the coil C may be such as to diminish the potential at the terminal T_1 of the induction coil, and therefore weaken the current through

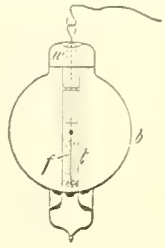


FIG. 10. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—SHOWING THE INFLUENCE OF THE CONDUCTIVITY OF THE MEDIUM UPON ELECTROSTATIC ACTIONS THROUGH MEASURABLE DISTANCE.

the primary of the coil C. Or the disconnecting of the plate may diminish the capacity effect with relation to the primary of the latter coil to such an extent that the current through it is diminished, though the potential at the terminal T_1 of the induction coil may be the same or even higher. Or the result might have been produced by the change of phase of the primary and secondary currents and consequent reaction. But the chief determining factor is the relation of the self-induction and capacity of coil C and plate P_1 and the frequency of the currents. The greater brightness of the filament in Fig. 15*a* is, however, in part due to the heating of the rarefied gas in the lamp by electrostatic induction, which, as before remarked, is greater when the suspended plate is disconnected.

Still another feature of some interest I may bring to your attention. When the insulated plate is disconnected and the secondary of the coil opened, by approaching a small object to the secondary, but very small sparks can be drawn from it, showing that the electrostatic induction

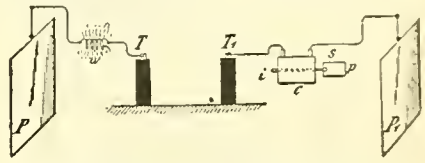


FIG. 11. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA —SHOWING EFFECTS OF CURRENTS FLOWING THROUGH OPEN CIRCUITS.

is small in this case. But upon the secondary being closed upon itself or through the lamp, the filament glowing brightly, strong sparks are obtained from the secondary. The electrostatic induction is now much greater, because the closed secondary determines a greater flow of current through the primary and principally through that half of it which is connected to the induction coil. If now the bulb be grasped with the hand, the capacity of the secondary with reference to the primary is augmented by the experimenter's body and the luminosity of the filament is increased, the incandescence now being due partly to the flow of current through the filament and partly to the molecular bombardment of the rarefied gas in the bulb.

The preceding experiments will have prepared one for the next following results of interest, obtained in the course of these investigations. Since I can pass a current through an insulated wire, merely by connecting one of its ends to the source of electrical energy; since I can induce by it another current, magnetize an iron core, and in short, perform all operations, as though a return circuit were used, clearly I can also drive a motor by the aid of only one wire. On a former occasion I have described a simple form of motor comprising a single exciting coil, an iron core and disc. Fig. 16 illustrates a modified way of operating such an alternate current motor by currents induced in a transformer connected to one lead, and several other

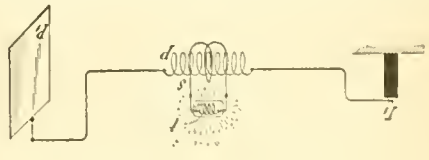


FIG. 12. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—CONVERSION ON OPEN CIRCUIT WITH COIL AND INSULATED PLATE.

arrangements of circuits for operating a certain class of alternate motors founded on the action of currents of different phase. In view of the present state of the art it is thought sufficient to describe these arrangements in a few words only. In the diagram, Fig. 16 II., shows a primary coil P, connected with one of its ends to the line L leading from a high tension transformer terminal T_2. In inductive relation to this primary P is a secondary S of coarse wire in the circuit of which is a coil c. The currents induced in the secondary energize the iron core i, which is preferably, but not necessarily, subdivided, and set the metal disc d in rotation. Such a motor M_2, as dia-

grammatically shown in Fig. 16 II., has been called a "magnetic lag motor," but this expression may be objected to by those who attribute the rotation of the disc to eddy currents circulating in minute paths when the core i is finally subdivided. In order to operate such a motor effectively on the plan indicated, the frequencies should not be too high, nor more than four or five thousand, though the rotation is produced even with ten thousand per second or more.

In Fig. 16 I a motor M_1, having two energizing circuits, A and B, is diagrammatically indicated. The circuit A is connected to the line L, and in series with it is a primary P, which may have its free end connected to an insu-

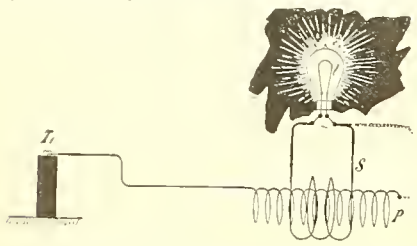
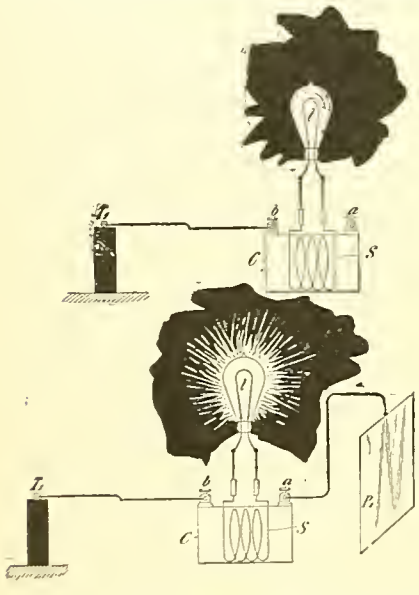


FIG. 13. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—CONVERSION ON OPEN CIRCUIT WITH COIL ALONE.

lated plate P_1, such connection being indicated by the dotted lines. The other motor circuit B is connected to the secondary S, which is in inductive relation to the primary P. When the transformer terminal T_1 is alternately electrified, currents traverse the open line L and also circuit A and primary P. The currents through the latter induce secondary currents in the circuit S, which pass through the energizing coil B of the motor. The currents through the secondary S and those through the primary P differ in phase 90 degrees, or nearly so, and are capable of rotating an armature placed in inductive relation to the circuits A and B.

In Fig. 16 III., a similar motor M_3 with two energizing circuits A_1 and B_1, is illustrated. A primary P, connected



FIGS. 14a AND 14b. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—EFFECT OF ATTACHED PLATE WITH LOW FREQUENCIES.

with one of its ends to the line L has a secondary S, which is preferably wound for a tolerably high electromotive force, and to which the two energizing circuits of the motor are connected, one directly to the ends of the secondary and the other through a condenser C, by the action of which the currents traversing the circuit A_1 and B_1 are made to differ in phase.

In Fig. 16 IV. still another arrangement is shown. In this case two primaries P_1 and P_2 are connected to the line L, one through a condenser C of small capacity, and the other directly. The primaries are provided with secondaries S_1 and S_2, which are in series with the energizing

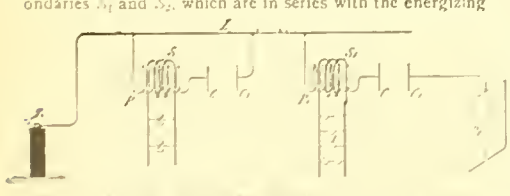
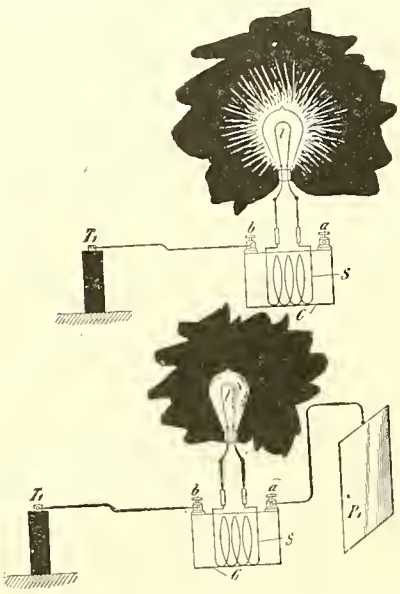


FIG. 17. [illegible] EFFECT OF PHENOMENA — [illegible] REGULATING THE EFFECT.

circuits A_1 and B_1 and a motor M_1, the condenser C again serving to produce the requisite difference in the phase of the currents traversing the motor circuits. As such phase motors with two or more circuits are now well known in the art, they have been here illustrated diagrammatically. No difficulty whatever is found in operating a motor in the manner indicated or in similar ways, and although such experiments up to this day present only scientific interest, they may at a period not far distant be carried out with practical objects in view.

It is thought useful to devote here a few remarks to the subject of operating devices of all kinds by means of only one leading wire. It is quite obvious that when high frequency currents are made use of ground connections are—at least when the electromotive force of the current is great—better than a return wire. Such ground connections are objectionable with steady or low frequency currents on account of destructive chemical actions of the former and disturbing influences exerted by both on the neighboring circuits; but with high frequencies these actions practically do not exist. Still, even ground connections become superfluous when the electromotive force is very high, for soon a condition is reached when the current may be passed more economically through open than through closed conductors. Remote as might seem an industrial application of such single wire transmission of energy to one not experienced in such lines of experiment, it will not seem so to anyone who for some time has carried on inves-



FIGS. 15a AND 15b. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—EFFECT OF ATTACHED PLATE WITH HIGH FREQUENCIES.

tigations of such nature. Indeed I cannot see why such a plan should not be practicable. Nor should it be thought that for carrying at such a plan currents of very high frequency are implicitly required, for just as soon as potentials of say 30,000 volts are used the single wire transmission may be effected with low frequencies, and experiments have been made by me from which these inferences are made.

When the frequencies are very high it has been found in laboratory practice quite easy to regulate the effects in the manner shown in diagram, Fig. 17. Here two primaries P and P are shown, each connected with one of its ends to the line L and with the other end to the condenser plates C and C^1, respectively. Near these are placed other condenser plates C^1 and C^1_1, the former being connected to the line L and the latter to an insulated larger plate P^2. On the primaries are wound secondaries S and S^1 of coarse wire, connected to the devices M and D respectively. By

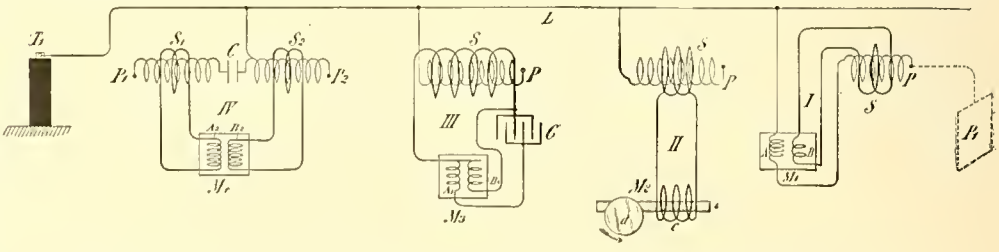


FIG. 16. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—WAYS OF OPERATING MOTORS WITH ONLY ONE LEAD.

varying the distances of the condenser plates C and C^1, and C_1 and C^1_1, the currents through the secondaries S and S_1 are varied in intensity. The curious feature is the great sensitiveness, the slightest change in the distance of the plates producing considerable variations in the intensity or strength of the currents. The sensitiveness may be rendered extreme by making the frequency such that the primary itself, without any plate attached to its free end satisfies, in conjunction with the closed secondary, the condition of resonance. In such condition an extremely small change in the capacity of the free terminal produces great variations. For instance, I have been able to adjust the conditions so that the mere approach of a person to the coil produces a considerable change in the brightness of the lamps attached to the secondary. Such observations and experiments possess, of course, at present, chiefly scientific interest, but they may soon become of practical importance.

Very high frequencies are of course not practicable with motors on account of the necessity of employing iron cores. But one may use sudden discharges of low frequency and thus obtain certain advantages of high-frequency currents without rendering the iron core entirely incapable of following the changes and without entailing a very great expenditure of energy in the core. I have found it quite practicable to operate with such low frequency disruptive discharges of condensers alternating current motors. A certain class of such motors which I advanced a few years ago, which contain closed secondary circuits, will rotate quite vigorously when the discharges are directed through the exciting coils. One reason that such a motor operates so well with these discharges is that the difference of phase between the primary and secondary currents is 90 degrees,

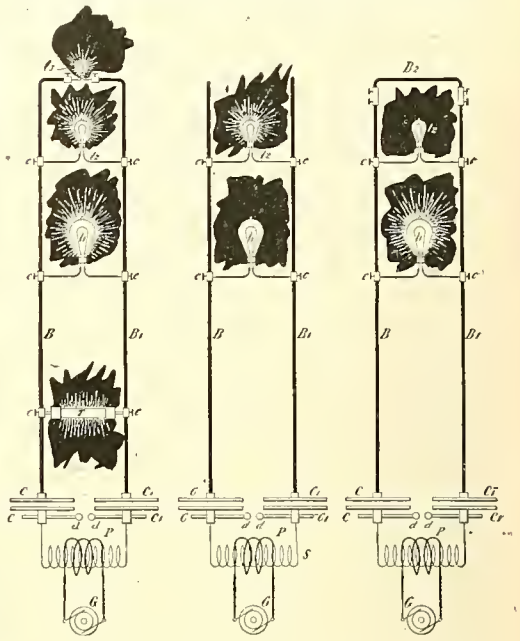


FIG. 19a, 19b, AND 19c. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—IMPEDANCE PHENOMENA.

which is generally not the case with harmonically rising and falling currents of low frequency. It might not be without interest to show an experiment with a simple motor of this kind, inasmuch as it is commonly thought that disruptive discharges are unsuitable for such purposes. The motor is illustrated in Fig. 18. It comprises a rather large iron core I with slots on the top into which are

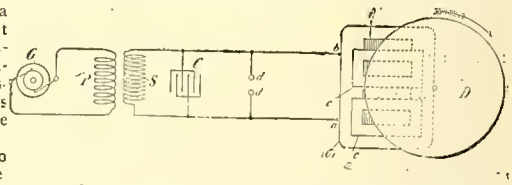


FIG. 18. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—OPERATING A MOTOR BY DISRUPTIVE DISCHARGES.

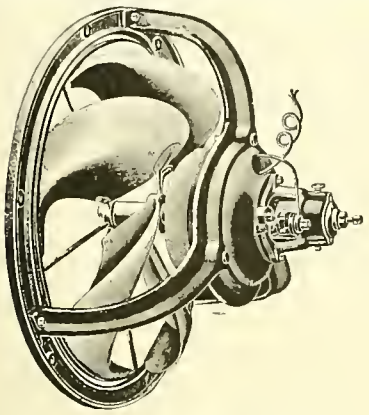
embedded thick copper washers C C. In proximity to the core is a freely-movable metal disc D. The core is provided with a primary exciting coil C, the ends A and B of which are connected to the terminals of the secondary S of an ordinary transformer, the primary P of the latter being

connected to an alternating distribution circuit or generator G of low or moderate frequency. The terminals of the secondary S are attached to a condenser C which discharges through an air gap D D which may be placed in series or shunt to the coil C. When the conditions are properly chosen the disc D rotates with considerable effort and the iron core I does not get very perceptibly hot. With currents from a high-frequency alternator, on the contrary, the core gets rapidly hot and the disc rotates with a much smaller effort. To perform the experiment properly it should be first ascertained that the disc D is not set in rotation when the discharge is not occurring at D D. It is preferable to use a large iron core and a condenser of large capacity so as to bring the superimposed quicker oscillation to a very low pitch or to do away with it entirely. By observing certain elementary rules I have also found it practicable to operate ordinary series or shunt direct current motors with such disruptive discharges, and this can be done with or without a return wire.

Among the various current phenomena observed perhaps the most interesting are those of impedance presented by conductors to currents varying at a rapid rate. In my first

paper before the American Institute of Electrical Engineers I described a few striking observations of this kind. Thus I showed that when such currents or sudden discharges are passed through a thick metal bar there may be points at the bar only a few inches apart, which have a sufficient potential difference between them to maintain at bright incandescence an ordinary filament lamp. I have also described the curious behavior of rarefied gas surrounding a conductor to such sudden rushes of current. These phenomena have been since more carefully studied and one or two novel experiments of this kind are deemed of sufficient interest to be described here.

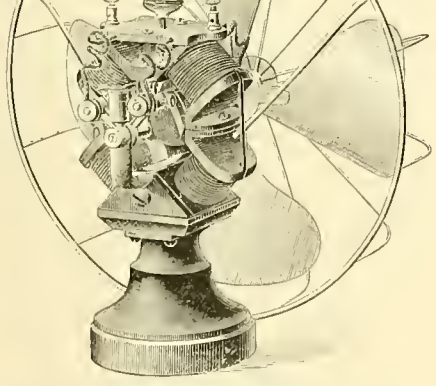
With reference to Fig 19 A, B and B_1, are very stout copper bars, connected at their lower ends to plates C and C_1, respectively, of a condenser, the opposite plates of the latter being



LUNDELL EXHAUST FAN OUTFIT.

connected to the terminals of the secondary S of a high tension transformer, the primary P of which is supplied with alternating currents from an ordinary low frequency dynamo G or distribution circuit. The condenser discharges through an adjustable gap D D as usual. By establishing a rapid vibration it was found quite easy to perform the following curious experiment. The bars B and B_1 were joined at the top by a low voltage lamp L_3; a little lower was placed by means of clamps C C a 50 volt lamp L_2 and still lower another 100-volt lamp L_1, and finally at a certain distance below the latter lamp an exhausted tube T. By carefully determining the positions of these devices it was found practicable to maintain them all at their proper illuminating power. Yet they were all connected in multiple arc to the two stout copper bars and required widely different pressures. This experiment requires, of course, some time for adjustment, but is quite easily performed.

In Figs. 19 B and 19 C two other experiments are illustrated which, unlike the previous experiment, do not require very careful adjustments. In Fig. 20 B, two lamps L_1 and L_2, the former a 100 volt and the latter a 50 volt, are placed in certain positions as indicated, the 100 volt lamp being below the 50 volt lamp. When the arc is playing at D D and the sudden discharges passed through the bars B B the 50 volt lamp will, as a rule, burn brightly, or at least this result is easily secured, while the 100 volt lamp will burn very low or remain quite dark, Fig. 19 B. Now the bars B B may be joined at the top by a thick cross bar B_2 and it is quite easy to maintain the 100 volt lamp at full candle power, while the the 50 volt lamp remains dark, Fig. 19C. These results, as I have pointed out previously, should not be considered to be due exactly to frequency but rather to the time rate of change which may be great even with low frequencies. A great many other results of the same kind equally interesting, especially to those who are only used to



ATLANTIC FAN MOTOR.

manipulate steady currents, may be obtained and they afford precious clues in investigating the nature of electric currents.

In the preceding experiments I have already had occasion to show some light phenomena, and it would be now proper to study these in particular; but to make this investigation more complete I think it necessary to first make a few remarks on the subject of electrical resonance which has to be always observed in carrying out these experiments.

Acme Portable Testing Set.

The Acme portable testing set, illustrations of which are presented herewith, comprises a Wheatstone bridge, rheostat, D'Arsonval galvanometer, aluminum-iodine battery and double contact key, all contained in a mahogany case weighing less than six pounds complete. The leather case illustrated in Fig. 1 is very convenient when the apparatus is used by inspecting engineers, as it can be slung over the shoulder and carried as readily as a small hand bag.

The coils in both bridge and rheostat are wound with platinoid wire, and adjustments are made with great care. The arrangement is similar to the "post office" design, with three coils in each bridge arm, and 18 coils in the rheostat, giving a total range by means of the reversing attachment of from .001 ohm to 11,110,000 ohms.

The galvanometer is a modified form of the D'Arsonval type, strongly built, and perfectly dead-beat. Magnetic fields and mechanical vibrations, it is claimed, produce no effect whatever, and the instrument will give as accurate indications in the street, on shipboard or in the dynamo room as in a college laboratory.

The battery is of the new aluminum-iodine form with an electromotive force of one and four-tenths volts per cell, or equivalent to a total of 17 volts.

In Fig. 2 A and B represent the two proportional bridge arms, R is the adjustable rheostat, and X the unknown resistance or line. In Fig. 3 the arm A of Fig. 2 is equivalent to the coils, 1, 10, 100, on the left hand center row, and the arm B to the coils 10, 100, 1,000 on the right hand of same row. The rheostat R corresponds to the coils of the top and bottom rows, aggregating 11,110 ohms, and X, the unknown quantity, is connected

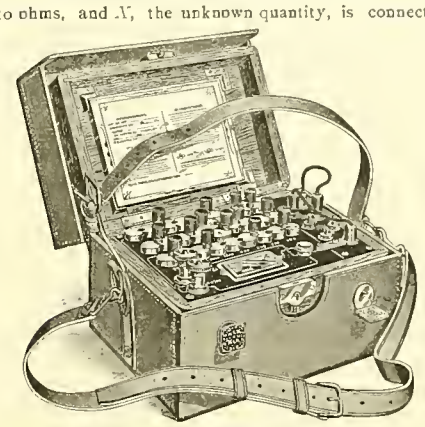


FIG. 1. ACME PORTABLE TESTING SET.

between the two binding posts at the lower left hand corner

In Fig. 3 the blocks A, R, B and X are connected to the bridge arms and are the same as shown in the center of Fig. 2. They constitute the reversing arrangement whereby the bridge arms may be interchanged, and six coils be made to do the work of eight. Thus, when one plug is placed between A and R, and another between X and B, the order of the arms working clockwise, and beginning with R, will be $R : X :: B : A$. If the plugs are changed so as to connect A to X and R to B the order will be $R : X :: A : B$. By this means it also becomes possible to readily detect inaccuracies in the bridge ratios should any exist, and to eliminate them entirely in work. Thus, if the two 100 ohm coils of the proportional arms are slightly different this fact becomes evident in practice by reversing and balancing them. If with a given unknown resistance the resistance in the rheostat has a different value in one case than in the other, the two bridge coils must be slightly different, and the correct value of the unknown will be the mean of the two rheostat resistances used in obtaining the two balances.

The manufacturers of this set are Queen & Co., incorporated, Philadelphia. The firm is anticipating a large demand, and is holding itself in readiness to meet its orders and undoubtedly will push the set well to the front.

The Lundell Exhaust Fan Outfit.

In the accompanying illustration is presented a new outfit which is a combination of an ordinary exhaust fan directly coupled to a slow speed Lundell motor. The absence of belting and the noiselessness of the outfit are particularly noticeable. In restaurants this outfit, by being judicially placed, will serve to exhaust the air both in the restaurant and kitchen as well. It is adopted for all places, and is a sure means of keeping the air in a pure and wholesome condition. The Lundell exhaust fan outfit is placed on the market by the Interior Conduit & Insulation company.

Electric Railway System for Indiana.

An interesting story comes from Indianapolis in which it is said that the Central Indiana Electric Railway company contemplates an electric system on a larger scale than has as yet been attempted in this country. The capital stock is $1,500,000. The officers are J. T. Baker, president; W. B. Keep, first vice-president; Thomas Wilkinson, second vice-president; N. D. Pontius, secretary; R. T. Wilkinson, treasurer, and Dr. T. A. Gesner, general manager. The central point of the proposed system, at which will be located its general offices, power house and car and machine shops, is Noblesville, twenty miles north of Indianapolis.

The ramifications of the Central Indiana Electric Railway company will extend to the principal cities of the

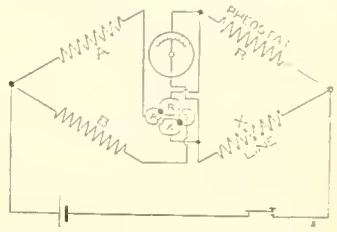


FIG. 2. ACME PORTABLE TESTING SET.

Indiana gas belt and its outskirts. A double-track system, according to present plans and specifications, is to extend from Noblesville to Indianapolis. A line to the west will extend to Lafayette by way of Frankfort. A line north will reach Kokomo and branch thence to Logansport and Peru. Another line northeast will connect with Elwood and thence with Marion and Fort Wayne. Another will extend to Muncie by way of Anderson.

To complete this system will require about 500 miles of main track. The company proposes to operate a city railway system at Noblesville, and the council of that city has granted a franchise for thirty years. The proposed plan contemplates through and local trains for passenger traffic, with express and mail cars, as well as freight trains, and it is said that passengers and express and freight matter will be transferred as rapidly as on any of the steam railroads of the state.

The promoters of the project assert that they have enlisted capital from Philadelphia, Chicago and London, and that ample means are at at hand for the construction and equipment of the lines. The trolley system is to be employed at the start, but if the storage battery system is perfected so as to become practicable it will be substituted. The work of construction is to be commenced at once, and the line between Noblesville and Indianapolis is to be in operation by early autumn.

Atlantic Fan Motor.

In the accompanying illustration is presented the latest type of the Atlantic fan motor. This motor is possessed of a novel armature so constructed and wound as to utilize the induction currents. The high efficiency, which, in consequence of this construction, is claimed for the motor is a special feature which will attract the attention of the trade, and no doubt secure for the

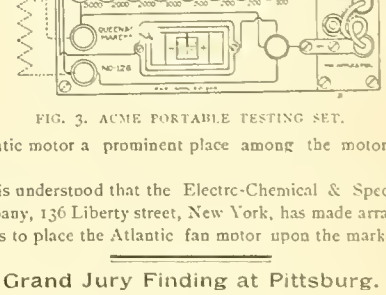


FIG. 3. ACME PORTABLE TESTING SET.

Atlantic motor a prominent place among the motors in use.

It is understood that the Electro-Chemical & Specialty company, 136 Liberty street, New York, has made arrangements to place the Atlantic fan motor upon the market.

Grand Jury Finding at Pittsburg.

A dispatch from Pittsburg, dated June 7th, announces that the grand jury has returned true bills for conspiracy against C. A. Coffin, of Boston, president of the General Electric company; W. J. Clarke, of Lynn, Mass., manager of the railway department; Milton H. Hamilton, of New York, E. W. Rice, of Lynn, and H. W. Knight, of Boston. All these gentlemen are officials of the General Electric company. True bills were also found against Morris W. Mead, superintendent of the bureau of electricity in Pittsburg for conspiracy, and against C. E. Christian, John Butler and Frank Carey, former employes of the Westinghouse company, for conspiracy and larceny.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 10.—What promised to be a dull session of the Rapid Transit commission on Wednesday was enlivened by a "set-to" of considerable earnestness and warmth between Commissioners Starin and Spencer. The latter accused the former of making a "business mistake" in opposing the attempts to come to terms with the Manhattan Elevated Railroad company. "Well," replied Mr. Starin, "I didn't have that interest in it that you had." Mr. Spencer, white and trembling with anger, said "If any man says that I have acted in this commission in advocating what was best for the city in the form of extensions to the present elevated system from any interested motives whatever, he is either so ignorant of the subject that he is not entitled to have an opinion or he has a lie in his throat while he utters it. He can take either horn of that dilemma that he wants to." Mr. Starin stated that he didn't propose to take either. Then followed some quite picturesque dialogue, in which personalities and recriminations were freely interwoven. Mr. Starin accused Mr. Spencer of having made a certain compromising statement with regard to the Manhattan system. Mr. Spencer retorted: "That statement is absolutely untrue." Mr. Starin threw his head back defiantly, with the remark: "One misfortune with me is that my memory is good." "That isn't your only misfortune," returned Mr. Spencer, and so the altercation went on until the chairman was reduced to a state of despair and nervous exhaustion, and all hope of any real business being arrived at, much less accomplished, had to be abandoned. One little incident throws a light on the engrossing nature of the interchange of rhetorical fireworks between the two commissioners. At an early stage of the meeting business appeared to be proceeding slowly, and Mr. Inman, one of the commissioners, who is somewhat deaf, is said to have laid down his ear trumpet on the table and remarked: "Down in the country where I lived everybody turned out for closing exercises at the school. One old fellow in the rear of the crowd found the proceedings tiresome, and thought he would take a nap. So he said to the man next to him, 'If anything good comes along, kick me.' I say, now, if anything happens worth my listening to, give me a shove." Soon after Mr. Inman put up his ear trumpet without being shoved and kept it in place until the meeting adjourned. The next day four of the Rapid Transit commissioners resigned and left Mr. Starin to hold the fort. This is probably the last stage of the present rapid transit fiasco, and everything now awaits the pronouncement of the mayor. As has been pointed out by a leading daily, the most sanguine could hardly expect any result from the work of such a commission that would be unreservedly for the public good. The Tammany taint was on it from the beginning. A Tammany lawyer was its counsel. Rumors and almost definite allegations that Tammany had struck a bargain from the beginning with the elevated roads, and was pledged to prevent any feasible underground system, hampered and handicapped it all the way through. There was the ideal system of an electric underground road, with all its immense advantages, that could have been working within two years, waiting and ready. It is scarcely to be supposed that capital would have been forthcoming, in the enormous amount required, even if a reasonable and practicable plan of underground transit had been devised by the commission. To-day it seems as if either the work of the last two and a half years will go for nothing, and the rapid transit farce will have to be played over again, or that the one remaining hope of rapid transit will lie in allowing the Manhattan company to do whatever its own interests may dictate, upon such terms as its officers and directors may propose.

The franchise of a New York city street railroad is worth paying for. The cable cars now running on Broadway take an average of $10 per trip, as against the horse car average of $4.70. There were thirty cable cars running yesterday, and, according to the present schedule, the gross earnings of the Broadway road will be over $10,000 per day.

Even Brooklyn wakes to life when street railroad options are wooing the spirit of enterprise. Last night the railroad committee of the Brooklyn Board of Aldermen met in the city hall to listen to propositions for using the streets for electric traction. The two competing corporations were the Union Street Railroad company and the Nassau Electric Railroad company. The Union offered to pay $15,000 a mile for the old Union street and Ninth avenue route, and, in addition, $10,000 a mile for several streets in the eastern district of Brooklyn and East New York and the Plaza. The representative of the Union, Mr. Gaynor, got the committee to promise that, in case anybody should outbid him, he would be notified and given the opportunity to raise his own offer. The representative of the Nassau company, on the other hand, states that his company is prepared to pay any price the aldermen may set for a franchise for the same streets, and impose no limit.

A meeting of the East River Bridge commission was held yesterday to hear arguments for and against the approaches to the new bridge and the condemning of property therefor. The kind of argument that obstructionists will fall back upon when they have nothing else to rely on was illustrated when Fordham Morris appeared for the property holders and urged that the present Brooklyn bridge had injured New York, because it induced people who would without it live in New York to live across the East River. "The only elevated roads which should be allowed in New York," said Mr. Morris, "are longitudinal ones." The two proposed new bridges, he said, would add to the injury, and the people of the city ought not to be encouraged to leave it. Mr. Uhlmann, on behalf of the Bridge commission, declared that the increase in the assessed valuation of property in Brooklyn and New York since the introduction of the elevated roads had been 65 per cent. in New York and 51 per cent. in Brooklyn.

On the 6th the linemen's strike was declared over, but the trouble has revived. President Cutler directed the strikers of the New York & New Jersey Telephone company, employed on the New Jersey division, to go to work, promising to consider their demand for increased pay. About two-thirds of the strikers returned to work, but others were informed that their services were no longer required. During the strike the company engaged non-union linemen and made yearly contracts with them. These men now fill the places of the strikers, and those of the strikers who were ring-leaders are discarded. The linemen who returned to work insisted that the company should reinstate all the old men, and this the company refused to do. It is thought, however, that an amicable settlement will be reached.

A case in which the liability of a telegraph company is defined has just been tried in the New York City Court. James Reilly, who brought an action against the Western Union Telegraph company, owns a sloop, which, on September 13, 1892, was at Bath Beach, L. I. On that day the weather was stormy, and Mr. Reilly sent a telegram from the Western Union office, at Grand and Hester streets, at 12:15 P. M. to a man in charge of the boat, with orders to put it in a place of safety. The telegram was not delivered until 2:30, and in the meantime the boat was badly damaged. Mr. Reilly sought to recover $234.50 damages. The Western Union, when sued, contended that it was absolved from liability on account of the contract on the message blank. The court and jury, however, rendered a verdict for the full amount, with interest and costs. W. F. O.

New England Notes.

BOSTON, MASS., June 10.—The legislature has modified the underground wire bill so that it now applies to all overhead wires except the trolley wires. But before this bill goes into effect, taking it for granted that it will pass, a large portion of the wires of the city will be underground or in process of being placed there by the own volition of the companies operating them. The present law allows electric companies to place their wires under the streets by obtaining permission of the local authorities. There are probably 20,000 miles of electric wires in the vicinity of Boston. The New England Telephone company has about half of this mileage, and the remainder is divided between the city of Boston fire and police alarm wires, the Edison, Boston Electric, Western Union, Postal Telegraph, District Messenger and a few smaller concerns. Of this mileage more than half is already underground. Three-quarters or more of the New England telephone wires are in the conduits, and about two-thirds of the Western Union and the Edison companies about the same. But the Boston Electric Light company's wires are all above ground. The city of Boston has been very backward in putting its own wires underground. The conduits of the telephone company have been completed about five years and the city has the right to use them, but the work was not begun till last fall, and of the 1,300 miles of wire belonging to the city not a tenth part is under the surface.

The West End Street Railway company is soon to try the plan of welding its rails together, forming a continuous line. This is to do away with the jolting, the rapid wearing away of the ends of the rails where the joint comes, and prevent the loss of power as well as injury to underground wires and pipes, caused by a leakage of power. The rails forming an unbroken line they will form a return circuit. The process to be used is that devised by the Johnson company of Johnstown, Pa., in conection with the Thomson Electric Welding company. A welding machine has been built at Lynn for this purpose. The apparatus is mounted on wheels to be run on the car tracks and is larger than an ordinary electric car. It is divided into sections, in one of which is placed the motor-dynamo, the switchboard, etc. In another are large tanks of water which furnish hydraulic power for some of the adjustments by means of an electric pump and also provide a cooling circulation about the clamps of the welder. The welder is suspended from the forward end by a crane. The current from the trolley wire is transformed by the motor-dynamo into an alternating current of lower pressure and greater volume and is in the welder again transformed into a current with a voltage of about 6 or 8 and amperage of about 30,000. Fish-plates are placed on both sides of the joint, and after they are brought up flush the clamps of the welder are fastened upon them and the current welds them in about five minutes.

The West End has finally won its fight in the legislature against the incorporation of the Storage Battery Street Railway company, with right to use the West End tracks from Cambridge to Boston. The senate by a vote of 5 to 29 refused to pass the bill to a third reading. This action was taken after members of both legislative bodies had been to Milford on invitation of the storage battery people and inspected the operation of the system there.

The rapid transit bill has been somewhat modified by the finance committee to whom it was submitted after being reported favorably by the rapid transit committee. The changes provide that tenure of office of the commission shall be for four years, and that two of the members shall be residents of of Boston, and be removable by the governor at any time. Consequential damages from the elevated road or subway are expressly forbidden, the forfeited property if the operating contract is not kept, is to be the property of the city of Boston. The route is to be from Causeway street to Franklin Park, the width from 25 to 80 feet north of Court square, and from 25 to 35 feet south. South of the north end of Shawmut avenue the route is to be between that avenue and Tremont street.

One by one the obstacles in the pathway of rapid transit are being removed. It has been said by many who have appeared at the state house this session in opposition to an elevated road that it would be impossible for any one to raise the necessary backing for such a scheme. This idea was dispelled upon the receipt of a letter from the firm of Leland, Towle & Co. of Boston by the rapid transit committee, which stated that it was ready to build, equip, maintain and operate an elevated railway in Boston and suburbs. Leland, Towle & Co. is a reputable firm of bankers of the highest standing on State street.

The West End Street Railway company of Boston has declared a dividend of 4 per cent. for the first half of the current year. This will make the annual dividend 8 per cent. instead of 10 per cent. as in the past. The action was taken because it was considered that the higher figure was more than the company could pay in justice to itself until its construction work was completed. The reduction had a bracing effect on the stock in the market, as it was considered a conservative move.

The streets of Colebrooke, Me., are to be lighted with electricity.

The new power house of the Newton & Boston Street Railway company will be completed by July 1st.

Ground has been broken for the new battery shop of the Hopedale Electric company.

The town council of Johnston, R. I., has granted the Union Railroad company a 20-year franchise. It is given on condition that the company build a new route on Hartford avenue, and extend the Manton avenue route some 2,000 feet. The company is also to pay half of 1 per cent. of its earnings to the town.

The first arc machine of the new Westinghouse type is to be put in the station of the Canton Electric Light company.

The new electric road between Waltham and Watertown is open for travel The line is three miles long and cost $100,000.

The electric power plant at Tariffville, Conn., is nearly ready for operation. The power is to be transmitted 11 miles to Hartford. The generator is wound for 600 volts, but the current is transformed to 3,000 volts and then transmitted to the outskirt of the city where it is transformed back to 600. It will operate a motor of 315 horse power. This motor runs a long shaft on which are belted generators and dynamos which run arc and incandescent lights and motors. Not a pound of coal is used in the whole operation. J. C. E.

PERSONAL.

Ludwig Gutmann, electrical engineer, spent a few days in Chicago last week.

George Cutter, Chicago, left last Saturday for a brief business trip to Boston and New York.

M. J. Sullivan, so long identified with the *Street Railway Gazette*, Chicago, has accepted a position with the *Electrical World*, and will act as its World's Fair business representative during the period of the exposition.

C. S. Colton, formerly motor salesman of the General Electric company, Chicago, has severed his connection with this company, and has taken charge of the alternating motor department of Taylor, Goodhue & Ames, Chicago.

It is announced that George Cawley is about to retire from the position of chief editor of *Industries*, London, to engage in business as consulting engineer. Mr. Cawley has occupied his present position since the establishment of *Industries*, and is entitled to much praise for the able manner in which he has conducted that journal. Upon Mr. Cawley's retirement it is reported that there will be a complete change in the management of the enterprise.

NEW INCORPORATIONS.

Voorhees Electric company, Boston, Mass.; capital stock, $5,000; to manufacture and sell electrical appliances.

Twin City General Electric company, Ironwood, Mich.; capital stock, $400,000; to do electric lighting and railway business; E. D. Nelson, Ironwood, Mich.

Fairmount Railway company, Denver, Colo.; capital stock $10,000; to build an electric railway from Fairmount Cemetery to Montclair in Arrapahoe county, Colo.

Palouse Electric company, Palouse, Wash.; capital stock, $30,000; to engage in the business of public and private lighting by electricity; A. P. Fuller, Portland, Ore.

Miamisburg Electric company, Miamisburg, O.; capital stock, $100,000. manufacturing and dealing in all kinds of electrical and other machinery and appliances; Amos R. Clay, Miamisburg, O.

Jackson Electric Railway, Light & Power company; Jackson, Ia.; capital stock, $250,000; to carry on a general electric railway and power business in Jackson, Miss.; W. E. Hayne, Jackson, Miss.

Walker & Bedford Electric Alarm company, East St. Louis, Ill., capital stock, $300,000; to manufacture and deal in electric alarm money drawers, etc.; Keller & Starek, 142 North Broadway, St. Louis, Mo.

Tekoa Electric company, Spokane, Wash.; capital stock, $20,000; to engage in the business of public and private lighting, heat and power; to operate telephone and telegraph lines; W. T. McCaskey, Spokane, Wash.

Monterey & Pacific Grove Street Railway & Electric Power company, Monterey, Cal.; capital stock, $180,000; to build and operate a street railroad and generate and supply electricity for all purposes; R. H. Willey, Monterey, Cal.

Continental Gas company, Chicago, Ill.; capital stock, $10,000,000; to manufacture and deal in gas and electricity; to erect, maintain and manufacture plants, appliances, etc., for the operation of the same; John W Carrington, Jr., Phenix building, Chicago, Ill.

Donahoo Steel & Smelting company, San Francisco, Cal.; capital stock, $500,000; to deal in iron, coal, timber and other lands; to mine, mill and smelt ores; to manufacture iron and steel, fuel gas, electricity, etc.; Edward R. Taylor, San Francisco, Cal.

Lawrence Electric company (incorporated in W. Va.), New York, N. Y.; capital stock, $1,000,000; furnishing electricity, acquiring patents, etc., relative to the construction of electric plants, furnishing motive power for cars, boats, etc.; George M. Pinoey, 44 Pine street, New York, N. Y.

ELECTRIC LIGHTING.

The question of establishing an electric light plant at Hart, Mich., is being agitated.

The New Orleans, La., city and lake railroad is being rapidly changed to adapt it to electric power.

The electric lighting plant which is to supply Tucson, Ariz., with street lighting is nearly completed.

The Haverford, Pa., Electric Light company is rebuilding its electric light plant, which was recently destroyed by fire.

An electric lighting plant is to be installed at the new town of Eastland, in Marin county, Cal. About 1,000 incandescent lights will be required.

The Missouri Electric Light & Power company has transferred its property and good will to the Municipal Electric Lighting & Power company, both of St. Louis. About $1,500,000 is involved in the transaction.

Work has been commenced removing the electric light towers in Pittsburg, Pa. They cost $800 each and it is said proved very unsatisfactory. Bonds to the amount of $100,000 to cover the cost of changing the system have been issued.

The local authorities have made a contract with the Brattleboro, Vt., Gas Light company to furnish arc lights for street lighting for a term of five years. The rate fixed is $90 per light a year.

Although electric lights are in general use on lake steamers the first trouble from crossed wires occurred on the new steamer, Selwyn Eddy, at Buffalo, N. Y., last month. Only three hundred bushels of grain were burned, but the smoke damaged the entire cargo of oats and the loss will be $100,000.

San Francisco and Los Angeles capitalists will put up an electric light plant in Monrovia, Cal., to run by water power obtained from the Saw Pit canon near that place for supplying the town and four neighboring towns with electric light and to run a projected electric railway from Monrovia via Pasadena to Los Angeles.

A special election was recently held in Paw Paw, Mich., on the question of bonding the place for the sum of $15,000 for the purpose of putting in an electric light plant. The proposition was carried but it is considered doubtful if the legal authority exists for the issue of bonds and it is possible that the matter will find its way into the courts.

The municipality of Munich has decided to adopt the electric light for the illumination of the principal thoroughfares, squares and public buildings, and to begin with a plant of 300 arc lamps for the streets and 1,800 incandescent lamps for the town hall. A considerable extension for the installation is to follow. The whole of the work has been intrusted to the firm of Schuckert & Co., Nuremberg, who undertake to complete the installation by October.

Considerable progress is now being made in the matter of electric lighting in Japan. Three new central stations, located respectively at Hamamatsu, Maibashi and Nikko, will be opened this month or next. The power in each case will be furnished by Pelton water wheels, which will drive 2,000 volt alternating current dynamos. The entire equipment will be constructed in Japan, even to the incandescent lamps. Nikko is a famous summer resort. All three of the cities are small and do not require more than 500 or to 1,000 incandescent lamps each.

ELECTRIC RAILWAYS.

Hillyard, Wash., proposes to have an electric railway.

Wabash, Ind., is considering the subject of electric railways.

The Amsterdam Street Railway company, Amsterdam, N. Y., will extend its lines to Fort Johnson.

It is expected that the Natchez, Miss., street railway will be operated by motors before January 1, 1894.

An electric railway between the two large Massachusetts cities, Lowell and Lawrence, is now but a question of time.

The Holyoke, Mass., Street Railway company contemplates the extension of its electric lines to the summit of Mt. Tom.

The construction of an electric railway between the towns of Malmö and Lund, in West Sweden, is under contemplation.

The Milan, Italy, council has authorized the Edison company to run an electric road two miles long for one year as an experiment.

The contract for building an electric line from Decherd, Tenn., to Winchester has been signed, and the road is to be in operation within six months.

The Arlington branch of the Pikesville & Pimlico electric road, controlled by the Baltimore Traction company, Baltimore, Md., has recently been completed.

It is said that the Chicago & St. Louis electric road has secured right of way through Fairbury, Ill., and the citizens of that town, it is reported, are raising $10,000 for the road.

The Muskegon Terminal Railway company, Muskegon, Mich., has been granted a right of way from the eastern boundary of the city along Eastern avenue and Clay avenue to Cedar street.

A movement is on foot among the business men of Mason, Bracken and Robertson counties, Kentucky, to secure the right of way for an electric line from Mt. Olivet to some point on the Chesapeake & Ohio road.

The new electric railway between New Albany, Ind., and Louisville is now being built, and the company expects to have the cars running soon; this line will reduce the time between the two cities twenty minutes.

The Pleasure Resort Railway company, with a capital stock of $100,000, has been formed to build an electric line from Denver, Colo., to North Denver, and to eventually extend it to Rocky Mountain and Berkeley Lakes.

The amended electric street railway bill having passed both Houses of Connecticut, it is quite likely that there will be an era of electric railway construction in the near future in the state, as something like seventy companies are said to have applied for charters.

An ordinance has been passed by the city of Trinidad, Colo., granting a franchise over certain avenues and streets of the city to the Trinidad, San Luis Valley & Pacific Railway company for laying tracks and constructing telegraph and telephone lines.

An enterprise is on foot to connect the towns of Waterloo, Garrett, Auburn, Ashley and Hudson, Ind., by an electric railroad. Rights of way will be asked of the town councils and board of county commissioners along the streets and public roads of the proposed lines.

The Union Electric Railway company, New York, has gained possession of the lines of the Westchester Electric company, which, when completed, will run from the Hudson River to Long Island Sound. The Union company will extend its present system from Fordham, meeting and connecting with the new line at Woodlawn. It is stated that the Union company has also acquired title to all of the other lines operated in the lower part of Westchester county.

The Canadian General Electric company, which recently received the concession for an electric tramway at Peterborough, Ont., has amalgamated with the Peterborough & Ashburnham Railway company under the charter of the latter for the purpose of constructing and operating the line.

The Calumet Electric Railway company, which operates a number of cross-town lines on the South Side, Chicago, has just completed arrangements with a number of railroads entering the city to transfer all their World's Fair passengers from the suburban station at which the road crosses the electric line to the fair grounds. The roads which have entered this agreement include the Rock Island, Marion, Erie, Baltimore & Ohio, Wabash, Pennsylvania and Lake Shore. A number of new cars will be added to accommodate the increased traffic.

TELEPHONE.

During the next few months Los Angeles, Cal., and San Francisco will be in direct communication by telephone, the wires running approximately along the course of the Southern Pacific railroad to San Luis Obispo, and from there through Santa Maria, by the way of Guadalupe, and from Santa Maria to Lompoc. The work is being pushed as rapidly as possible, and is to be of the most substantial character. A heavy copper wire is being used, weighing 460 pounds to the mile. The transportation of the poles has cut a large figure in the cost of the enterprise. The poles each weigh about 700 pounds.

MISCELLANEOUS.

An ordinance is to be introduced in the Baltimore City Council, it is said, providing for a tax of two dollars on each electric light, telephone and telegraph pole, and on each trolley pole which carries wires other than those in use by the railway.

A company has been organized and application has been made to the city for a franchise to construct underground conduits for electric wires in Syracuse, N. Y. A company has also been formed at Utica for a like purpose.

TRADE NEWS.

The Ansonia Electric company has just effected a large sale of Shield brand wire in Iowa. The wire continues to give every satisfaction.

The Montreal Street Railway company is equipping its new power house with Westinghouse multipolar generators supplied by the Canadian agents, Ahearn & Soper, Ottawa.

The American Circular Loom company of Boston has made arrangements with C. E. Woodruff & Co., 235 Lake street, Chicago, for the sale of its canvas jacket covered wire.

That mica is rapidly being adopted by the leading electric concerns for insulation purposes is evidenced by the large increase in sales of Eugene Munsell & Co., of New York.

The American Cotton Oil company, New York, is having its mills in Arkansas rewired with Okonite wire and all modern safety devices placed under the supervision of T. L. Rose, electrical contractor, of Little Rock.

The Buckeye Electric company, manufacturer of incandescent lamps and appliances, is having a large sale for its double coil filament, 32 candle power lamp. This lamp is one of remarkable durability and illuminating power, and is sure to be one of long continued popularity.

The Hart & Hegeman Manufacturing company, of Hartford, Conn., manufacturer of Hart switches, reports that, that during the month of May the sales were larger than during any previous month since it has been in business.

Charles L. Livingston announces that he is prepared to contract for the complete equipment of electric street railways, central stations, isolated plants, etc. Special attention will be given to wiring of fine residences, business blocks and churches. His office is located in the Fidelity building, 121 Fourth avenue, Pittsburg, Pa.

The Iowa Electric & Construction company, 508 Walnut street, Des Moines, Ia., successor to the Hess Electrical company, is prepared to do all kinds of electrical construction work, particular attention being paid to central station and isolated light plants, electric combination and gas light fixtures, electric motors and dynamos, electric bells, burglar alarms and annunciators.

Secretary F. W. Davis, of the Perkins Electric Switch company, of Hartford, Conn., reports that his company was never more busy than at present. The demand for its new lamp socket, which possesses many features of distinctive merit, has been most satisfactory. The calls for its new dove-tail ceiling rosette have largely increased since January 1st.

The Eureka Tempered Copper company, North East, Pa., has issued a tastefully compiled little book as a souvenir of electricity building, World's Columbian Exposition. The pamphlet contains many endorsements as to the efficiency of Eureka tempered copper wire, and also the statement of the sub-committee of science and arts, Franklin Institute of Philadelphia, in awarding to the company the John Scott medal.

The Heinze Electric company of Lynn, Mass., has been obliged recently to run its factory over-time to meet the demand for its new fan motor which operates on both alternating and direct currents, and which will run for a long time without attention. These features recommend it to

the trade as a first-class fan motor. This company has also under way a new line of instruments which it expects to become popular in the electrical trade.

Purchasers of insulated wires of all kinds will be interested to know that the Chicago Insulated Wire company has decided to remove its Chicago office to Sycamore, Ill., to which place all communications should be addressed. The Chicago Insulated Wire company has for some time occupied an office at 214 Northern building, Chicago, but the company lately decided that its business would be greatly facilitated by the location of its offices at the works in Sycamore, Ill.

The John Hopkins University of Baltimore has issued its register for 1892-93. Full particulars pertaining to the branches of studies pursued are given. Electrical engineering is given a prominent place, the course extending over a space of two years. It is intended to fit students for work on the latest advances in electrical science and the practical electrical problems of the day, especial attention being paid to the subject of electrical transmission of energy and to electric railroad work.

The J. H. & D. Lake company, manufacturer of all kinds of friction clutch pulleys, having outgrown its old quarters at Hornellsville, N. Y., has recently completed and removed to its new offices and foundry at Massillon, O., where with enlarged facilities, it is prepared to meet the growing demands of its business. An interesting feature regarding the rapid growth of the Lake company is the fact that it came almost exclusively from advertising, for with the exception of a limited amount of traveling, it has had no representative, except its card in the various trade jouroals.

The University of Minnesota, Minneapolis, has earned a well-deserved reputation for thorough equipment and capable instruction in its various departments, and there is none more complete than the electrical engineering branch. It is associated with the department of physics, without being made at all subservient to it, and has free use of all its apparatus and facilities for work. The electrical department includes three rooms for sensitive instrumeats, a dynamo room, battery room, four laboratory rooms, photometer, photographic, library and reading rooms, and offers particular advantages to one contemplating an electrical engineering course. A catalogue has just been published.

The recognition of the dangers attending the use of cotton waste in machine shops and manufacturing works has led to the establishment of the industry of manufacturing machine towels from silk waste. The office of this enterprise is located at 809 North Second street, St. Louis. It is known as the American Silk Manufacturing company. One feature of these towels, not the least important, is the thoroughness with which they clean machinery. They not only leave no small fiber to work into the finer parts of the machinery, and thus in time affect it to such an extent as to necessitate repairs, but they possess the property of taking up and retaining in their meshes any rust or particle of foreign matter with which they come in contact. Add to this the fact of their incombustibility and their cheapness, and it would appear that they were the ideal machine wipers.

George Porter, electrical contractor, 143 LaSalle street, Chicago, has just closed a deal with the Claremont hotel, Thirty-sixth street and Vincennes avenue, for the installation of a 700 light plant. The Claremont equipment will be a 90 horse power Westinghouse engine driving two Edison 360 light machines. Mr. Porter has also closed a contract to fit up the Cleopatra Sarcophagus, 335 Wabash avenue, with two electric light signs, one to be placed over the entrance to the building, and the other to be hung over the entrance to the tomb proper. The sign over the ontside entrance will be formed of white 10 candle power incandescent lamps. These lamps, through the agency of a motor driven commutator, will spell alternately the words "Cleopatra" and "Sarcophagus." The inside sign over the tomb will read "Cleopatra." Mr. Porter has also made a recent sale of thirty-five Holtzer-Cabot fan motors, and on his contracting work alone has now employed as many as twenty-four men. Such work as this speaks for itself.

Continued prosperity is evident from a perusal of the ninth edition, of the revised catalogue of W. R. Ostrander & Co., 204 Fulton street, New York. Since the issue of its last catalogue the company has added several new lines of electrical specialties, and enlarged its stock, until it presents one of the most complete and varied assortments before the public. The last catalogue comprises six systems: Speaking tubes, electrical call bells, electric burglar alarms, electric gas lighting, mechanical door bells and pneumatic call bells. Each system embraces all the branches of its department, and with the help of numerous illustrations presents its matter in a handy, compact form. As for the subject matter itself, it may be said that no more complete and varied stock has solicited attention from the trade. Covering as it does the whole field electrical appliances it cannot fail to attract the attention of electrical people. The firm has the advantage of a recently enlarged factory, which, with its force of skilled mechanics, give it exceptional facilities for filling all orders promptly.

BUSINESS.

The Central Electric company, Chicago, is furnishing the *Sentinel* building at Milwaukee with conduit and fittings, made by the Interior Conduit & Insulation company, for which it is the western agent.

The Marion Street Railway company of Marion, Ind., has commenced work on a line of road to Gas City via the Soldiers' Home. The Ansonia Electric company's new line of overhead railway fixtures will be used on the entire road.

C. E. Newton, of the Jewell Belting company of Hartford, Conn., desires to extend to the electrical fraternity a cordial invitation when visiting the fair to inspect the company's exhibit of belting, which is located at electricity building, F 6, ground floor.

The Electrical Piano & Motor company of Newark, N. J., manufacturer of the Feldkamp electro-magnetic fan, reports large sales for its fan in Texas. These fans are simple, noiseless and easily attached to a hook in the ceiling, and there is no chance of burning out.

Captain W. L. Candee, of the Okonite company, is spending a few days in Chicago looking after the company's exhibit at the Fair. The Okonite factory has been very busy and has been delayed in this particular, but the work is now well under way and it promises to make a creditable showing.

O. K. weather proof insulated copper wire continues to give its former satisfaction for use in line and house wire work, and feeder wires for railway work. As placed on the market by the Electrical Engineering & Supply company, St. Paul, Minn., its northwestern agent, it is sure to be pushed to the front.

The improved cable supporter for aeriel telephone, telegraph and electric cables, manufactured by O. N. Bender & Co. of Providence, R. I., is being adapted very largely for the support of wires, etc. One hanger will support 150 pounds. They are made in brass or zinc. This company is very busy with orders.

The Tice-Lintner Electric company, Minneapolis, Minn., manufacturer of electrical specialties, has been so successful in the electrical field that it has been obliged to remove its factories to Gladstone, Mich., where it anticipates a better location for shipment.

J. H. Cooke, western representative of the Buckeye Electric company, has in stock at Chicago 35,000 Buckeye lamps of standard voltage and candle power. The number will be increased to 50,000 as rapidly as possible to meet the heavy orders that are making the lamp one of the best sellers on the market. The factory of this company is located at Cleveland, O., and the western office at 182 Jackson street, Chicago.

The Eddy Electric Manufacturing company of Windsor, Conn., has recently appointed B. M. Barr as its representative for several middle states, with an office at 816 Cuyahoga building, Cleveland, O. Mr. Barr has a large and extensive acquaintance in the electrical field, being for many years connected with the Thomson-Houston company, and will no doubt prove a valuable acquisition to its business staff.

Former purchasers are taking advantage of the fact that the Ansonia Electric company can again furnish the old standard Sunbeam incandescent lamp. The orders are coming in daily in such abundance as to give truth to the statement that it has regained already its previous hold on the trade. This company, formerly known as the Electric Supply company, continues to enjoy the best of reports from its W. W. lightning arrester.

Queen & Co., incorporated, Philadelphia, have a new specialty in the Acme portable testing set, described elsewhere in these columns, which can hardly fail to meet with great favor. It is remarkably compact and complete, all necessary parts, including battery, being contained in one small and handsomely finished mahogany case that weighs only six pounds. The set is particularly well adapted to outside testing, but gives equally accurate results in central stations or factories and on shipboard. It will be extensively handled by the trade as a standard article.

ELECTRICAL PATENTS.

Issued June 6, 1893.

498,757. Insulated Conductor. Thomas F. Attix, Brooklyn, N. Y.

498,758. Lamp Socket and Key Holder Therefor. Henry P. Ball and Amandus Metzger, Schenectady, N. Y.

498,763. Electromotive Device. Romaine Callender, Brantford, Can.

The electromotive device comprises an electro-magnet adapted to act upon its armature, which is carried upon a pivoted lever. The armature is yieldingly held away from the magnet by a spring, and when attracted acts upon a pawl to rotate a ratchet wheel, from which power may be derived. The motion of the lever cuts resistance into the circuit containing the electro-magnet, thereby weakening it and permitting the armature to be withdrawn by the spring. Repetition of the operation continuously rotates the ratchet wheel.

498,768. Electrolytic Apparatus. Thomas Craney, Bay City, Mich.

498,769. Method of Electrolyzing Salts. Thomas Craney, Bay City, Mich.

498,770. Electrolytic Apparatus. Thomas Craney, Bay City, Mich.

498,771. Electrolytic Cell. Thomas Craney, Bay City, Mich.

498,776. Clamp for Electric Conductors. Axel H. Englund, Chicago, Ill.

498,799 Rheostat. Edward R. Knowles, Middletown, Conn.

498,808. Telephone Switchboard Annunciator. Frank R. McBerty, Downer's Grove, Ill.

498,852. Closed Conduit for Electric Railways. Charles J. Kintner, New York, N. Y.

498,865. Railway Signal. Joseph B. Stewart, Haverstraw, and William G. Wattson, Tappan, N. Y.

498,871. Electrical Transmitter for Telemeter Systems. Charles W. Ayton, New York, N. Y.

498,878. Electric Illuminating Apparatus. Edward A. Colby, Newark, N. J.

498,879. Method of Electric Illumination. Edward A. Colby, Newark, N. J.

The method consists in placing within a vacuum chamber a closed coil of conducting material adapted to become incandescent upon the passage of an electric current through the same, the filament thus formed being brought within the influence of a magnetic field of varying strength, such as may be produced by the passage of an alternating current through a coil of wire. The device shown comprises a hollow cylindrical glass receiver exhausted of air and provided with a closed coil composed of carbon or like material, while within the core of the cylinder is placed a coil of wire encircling a mass of magnetic material; the coil being traversed by an alternating current causes an induced current in the filament with the consequent incandescence of the filament.

498,880. Electrical Switch. James Des Brisay, New York, N. Y.

498,901. Incandescent Electric Lamp. Alexander de Lodyguine, Paris, France.

The lamp is provided with leading-in wires of iron, steel, or other of the baser metals, which are hermetically sealed into the glass bulb of the lamp by a glass seal containing compounds of boron

498,906. Conduit Railway Trolley. Michael H. Smith, Halifax, Eng.

498,907. Electrical Condenser. William Stanley, Jr., and William B. Tobey, Pittsfield, Mass.

498,911. Copying Telegraphic Apparatus. Sylvester P. Denison, Belleville, N. J.

498,915. Electrode for Electric Arc Lamps. Salomon Heimann, New York, N. Y.

The electrode comprises a carbon pencil provided with a refractory coating composed or a mixture of calcined soapstone, water glass, oil and lamp-black. These materials are ground together and then mixed with water, after which the carbon pencils are dipped into the mixture until a coating about one sixty-fourth of an inch thick is formed thereon.

498,919 Telephone. Barton Pickering, Dayton, O.

498,929. Electric Glow Lamp. Edward A. Colby, Newark, N. J.

The receiver is of glass in the form of a hollow cylinder of annular cross section, the filament being in the form of a closed coil. Within the hollow portion of the cylinder is placed a core of magnetic material carrying upon its end the primary coil adapted to be traversed by an alternating current.

498,932. Trolley Stand. James R. Griffiths, Chicago, Ill.

The trolley pole is provided at its lower end with a segmental gear wheel that engages with a rack occupying a horizontal position. Motion of the rack in either direction acts to place tension upon a coiled spring, thereby furnishing the resiliency that maintains the trolley wheel yieldingly in contact with the trolley wire.

498,933. Electric Railway Trolley. James R. Griffiths, Chicago, Ill.

498,969. Dynamo-electric Machine. William S. F. Dillon, Chicago, Ill.

The frame of the machine is cast so that the cores of the electro-magnets are hollow. They are afterward filled with iron filings and the like, thereby greatly cheapening the construction of the machine.

498,973. Method of and Apparatus for Electric Perforating. Dexter M. Garnett, Evanston, Ill., and John H. Garnett, Chicago, Ill.

498,988. Electric Signal and Protective System. Charles E. Ongley, New York, N. Y.

499,003. Electrical Call Box. Walter F. Banks, Milford, Conn.

499,062. Electric Time Signal. Gerhard W. Van Vianen, Cologne, Germany.

499,095. Trolley Wire Finder. James Chase, Rochester, N. Y.

499,097. Electric Illuminating Apparatus. Edward A. Colby, Newark, N. J.

The glass receiver is in the form of a hollow ring, the filament occupying a central position within the receiver, thus forming a ring filament. The ring is placed upon a magnetic core which is encircled by a coil of wire traversed by an alternating current, the ring filament thus acting as the secondary of a transformer. The passage of the current causes the filament to become incandescent. When desired the filament may be caused to glow only at particular sections by making a portion of the filament of material having a high resistance and the remainder of low resistance. As many of the ring-shaped receivers as may be desired may be placed upon a common core, thereby varying the brilliancy of the lamp.

499,099. Electro-dynamic Machine. Olof Dahl, Paterson, N. J.

499,108. Telephone. Edward M. Harrison, Fort Smith, Ark.

499,112. Overhead Electric Railway. John C. Henry, New York, N. Y.

499,115. Electro-railway Trolley. George W. Hooper, Rochester, N. Y.

499,125. Electric Signal Apparatus and System. Jacob W. Lattig, Easton, Pa.

499,126. Electric Signaling Apparatus and System for Railways. Jacob W. Lattig, Easton, Pa.

499,143. Trolley Wire Support. Carl Peterson, Brooklyn, N. Y.

499,150. Advertising or Other Illuminating Effects. Horace F. Simon, London, Eng.

499,167. Trolley Wire Curve. Rudolph M. Hunter, Philadelphia, Pa.

499,183. Friction Clutch for Electric Motors. Olof Dahl, Paterson, N. J.

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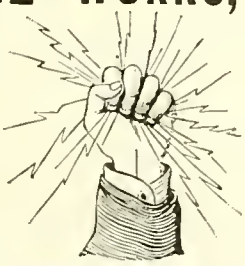

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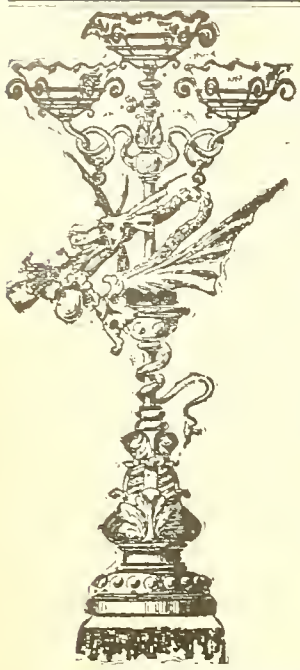

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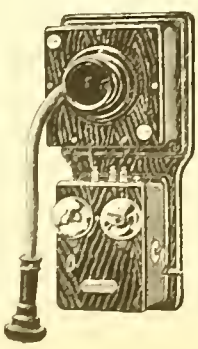

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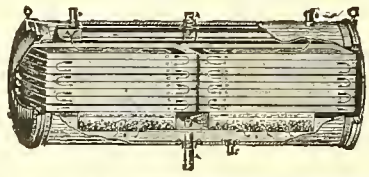

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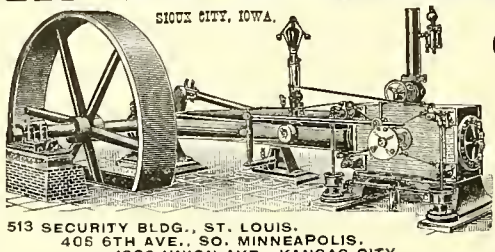

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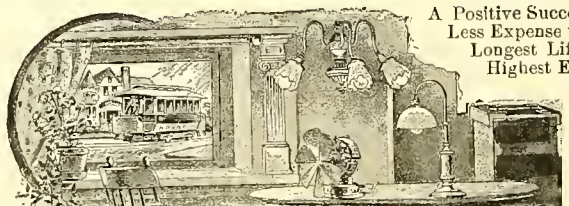

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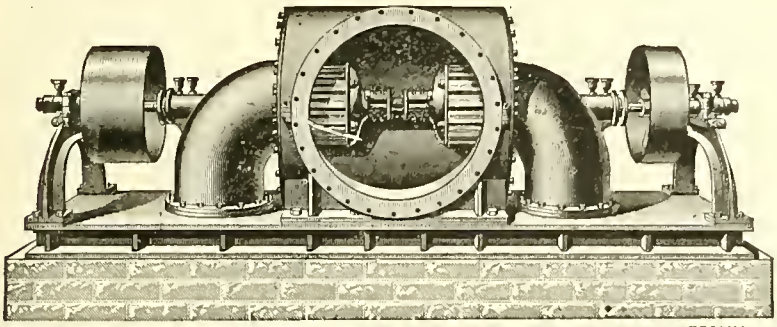

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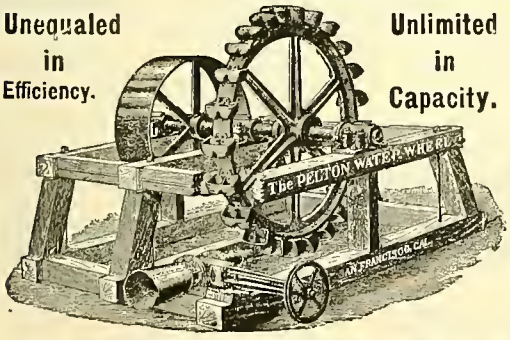

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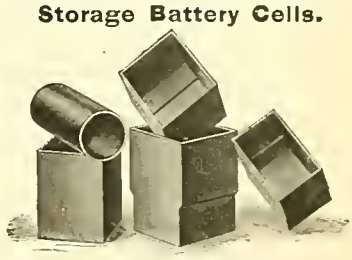

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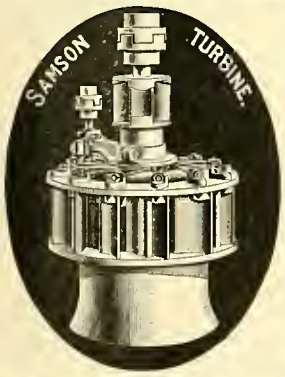

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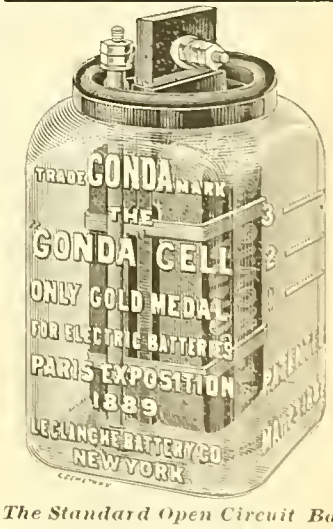

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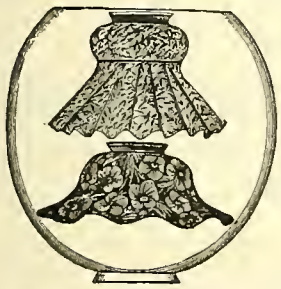

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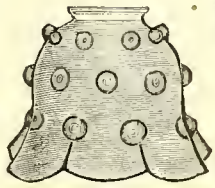

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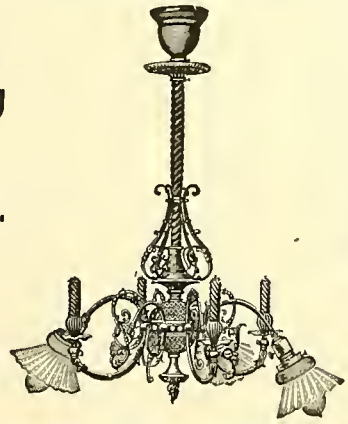

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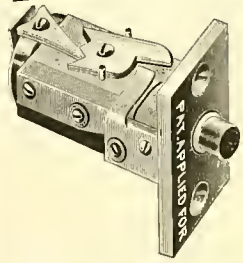

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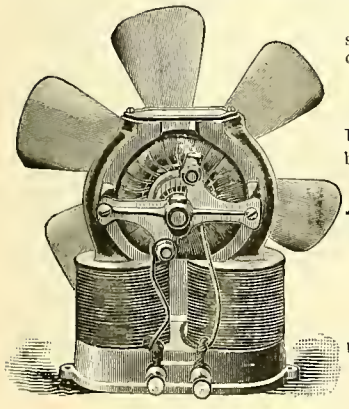

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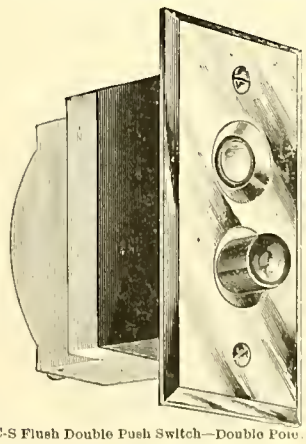

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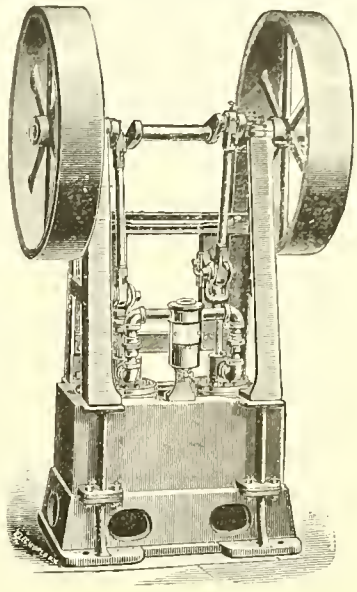

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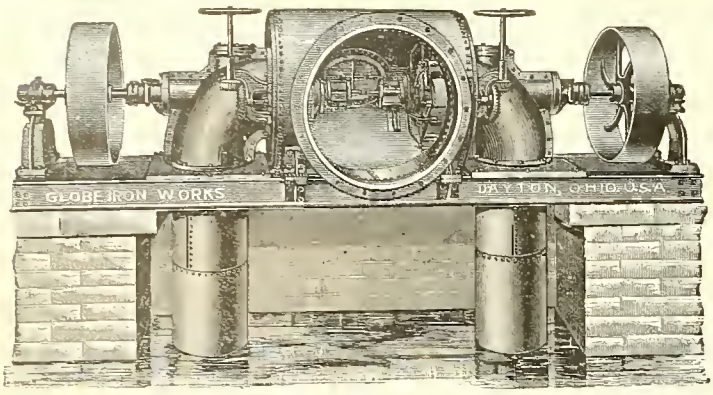

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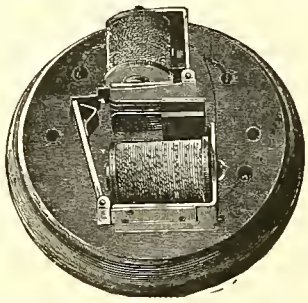

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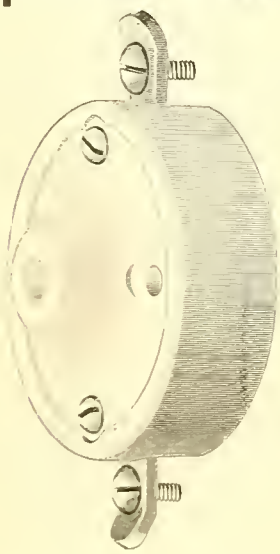

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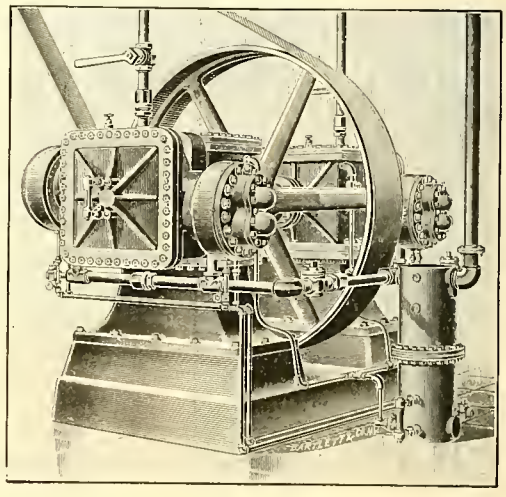

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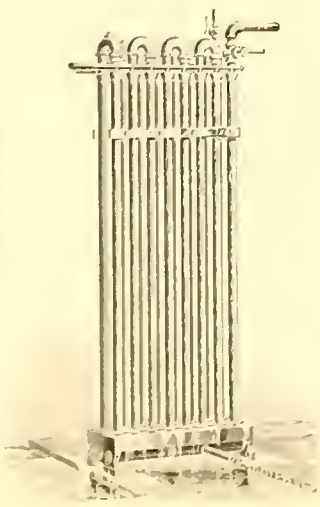

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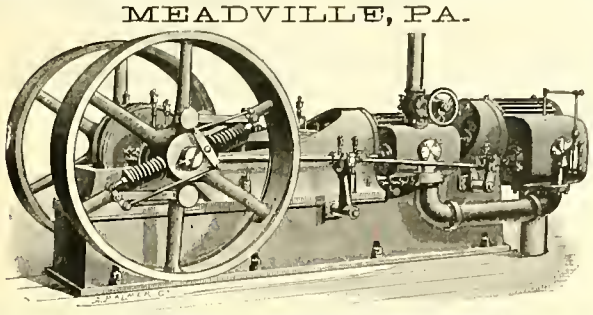

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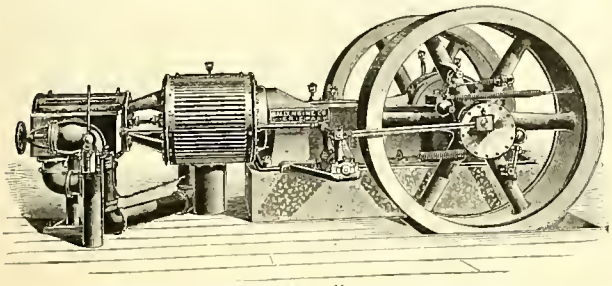

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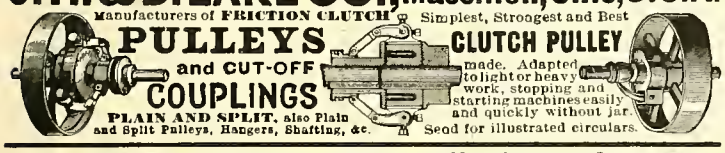

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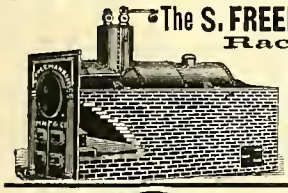

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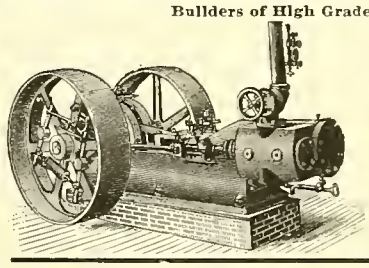

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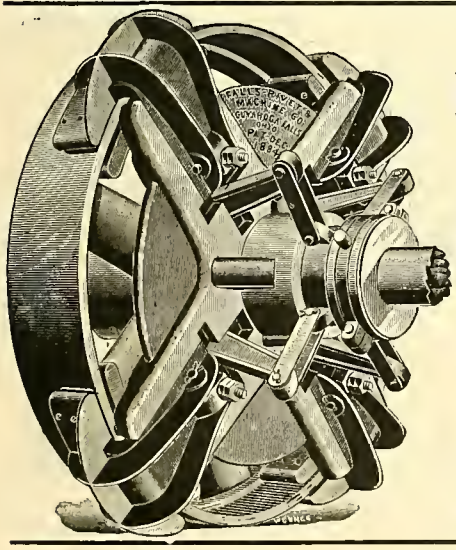

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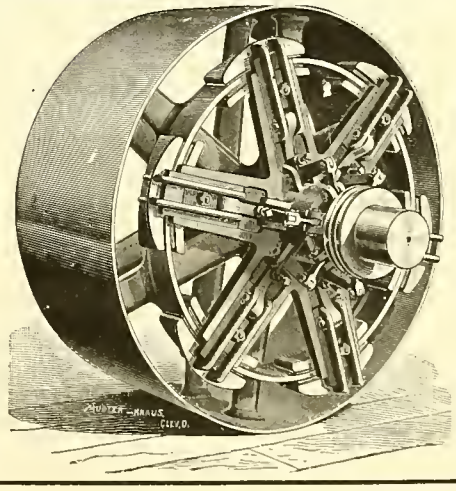

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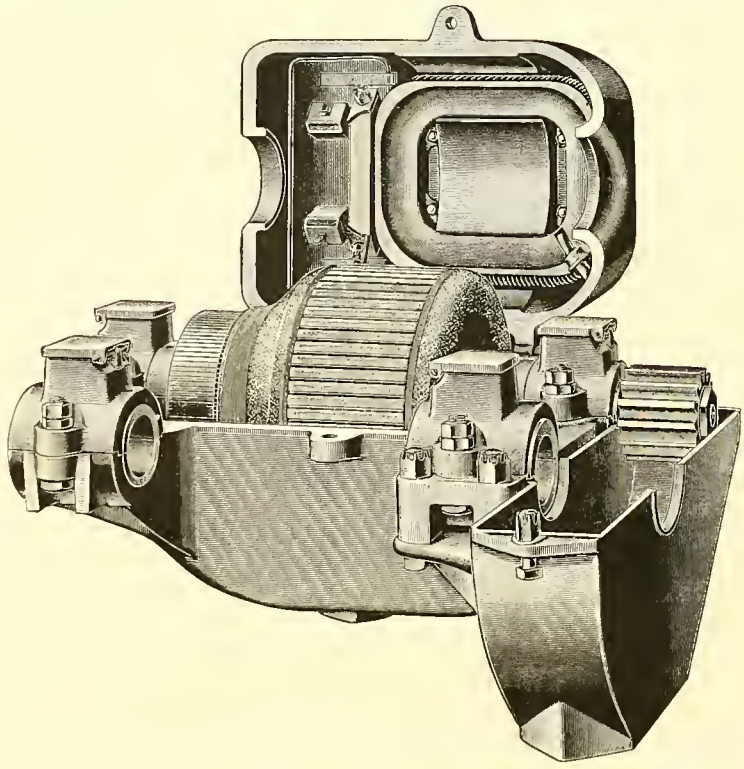

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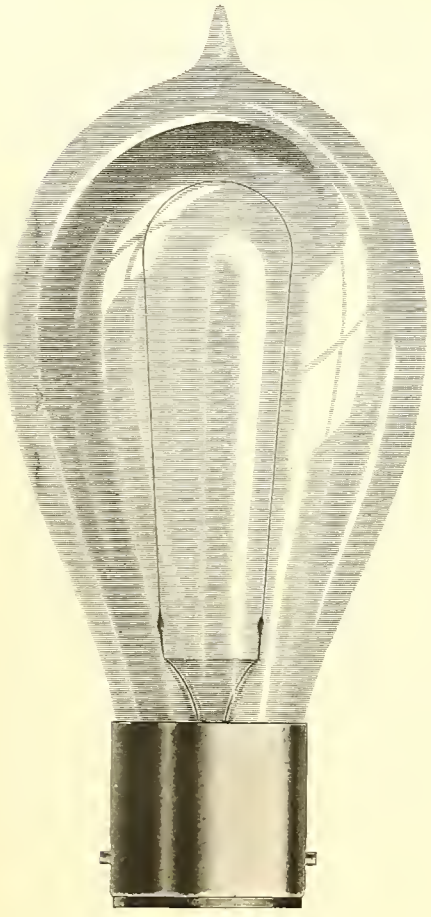

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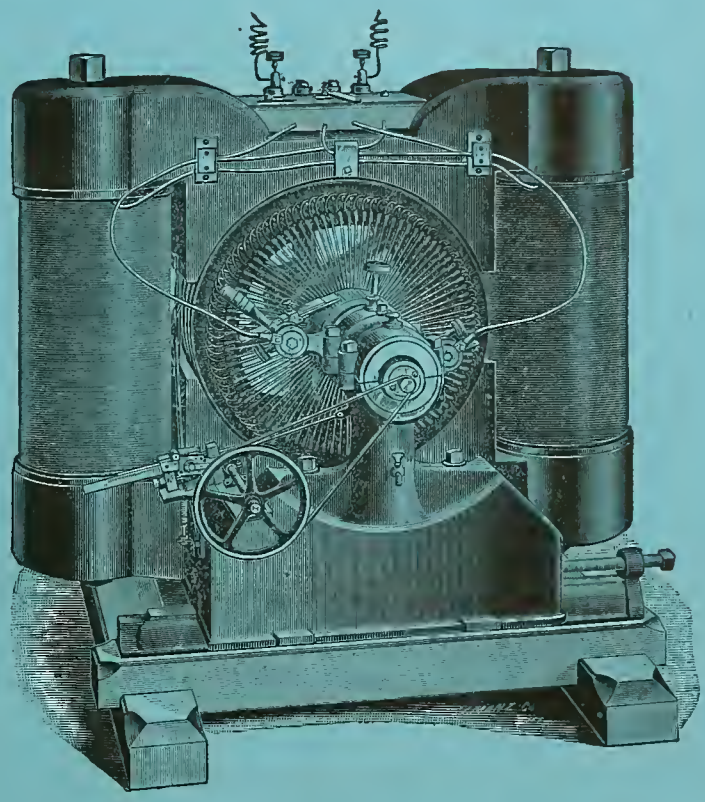

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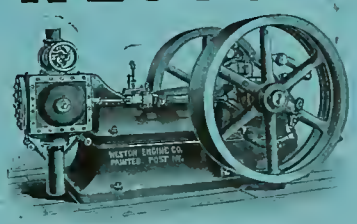

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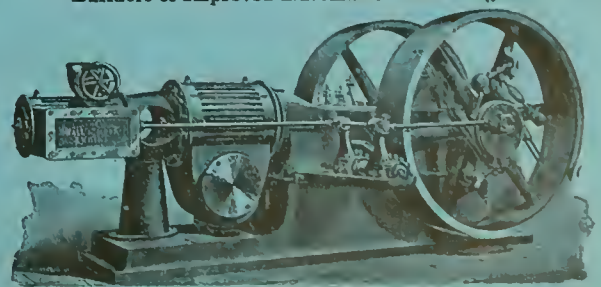

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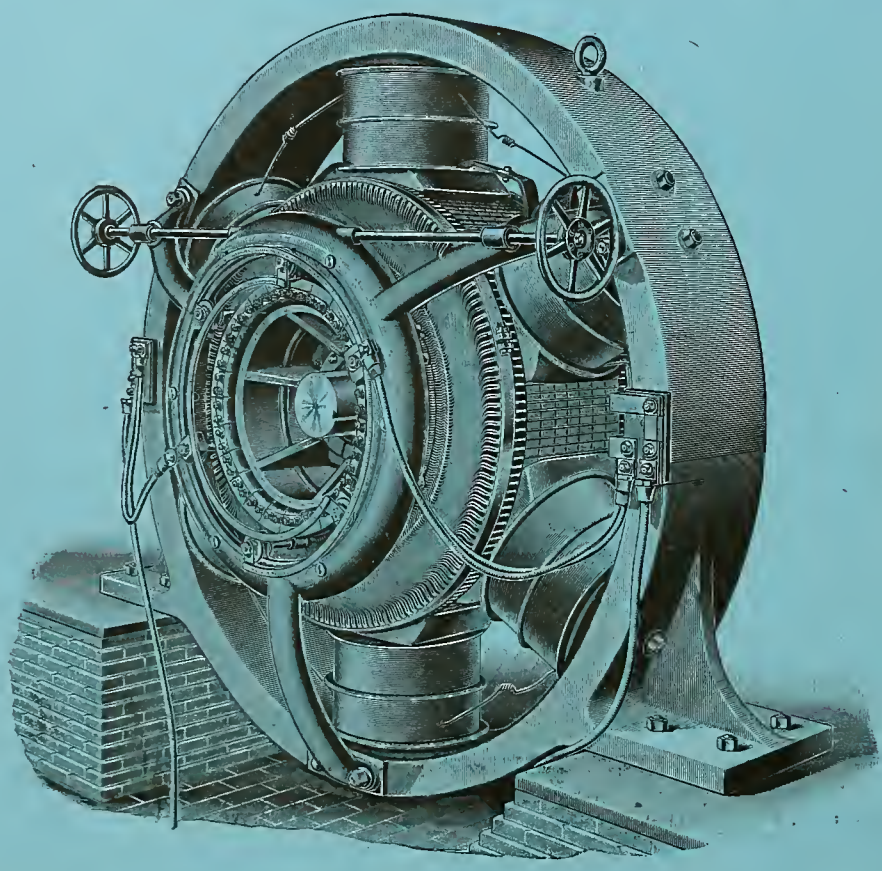

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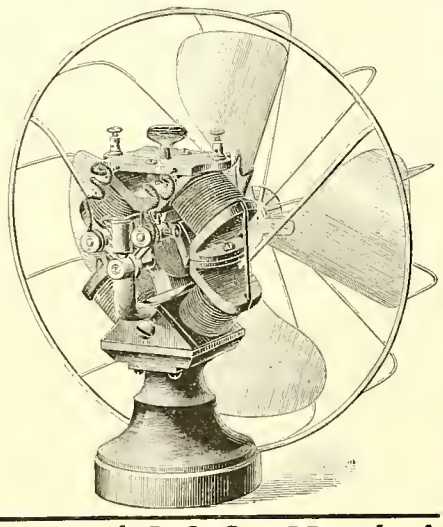

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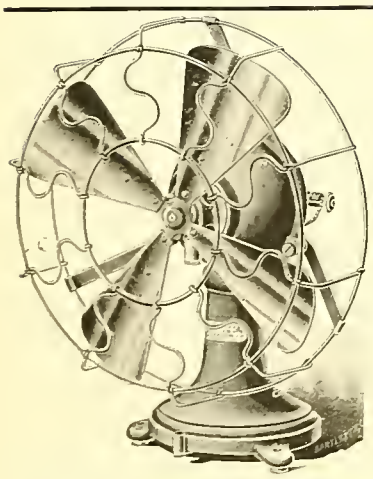

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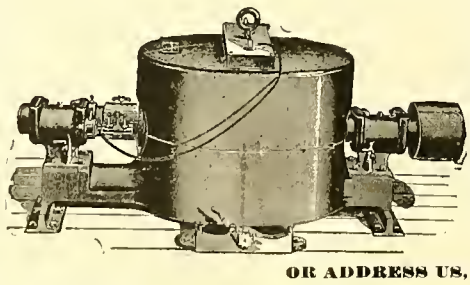

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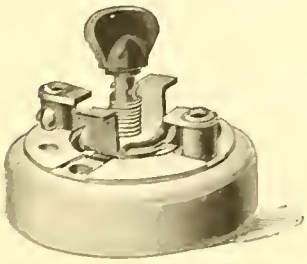

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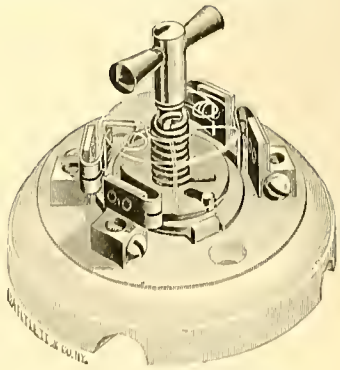

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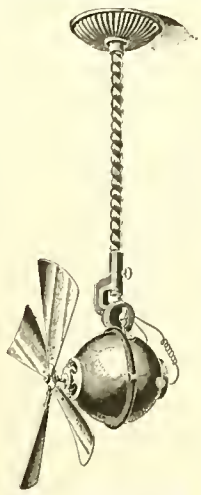

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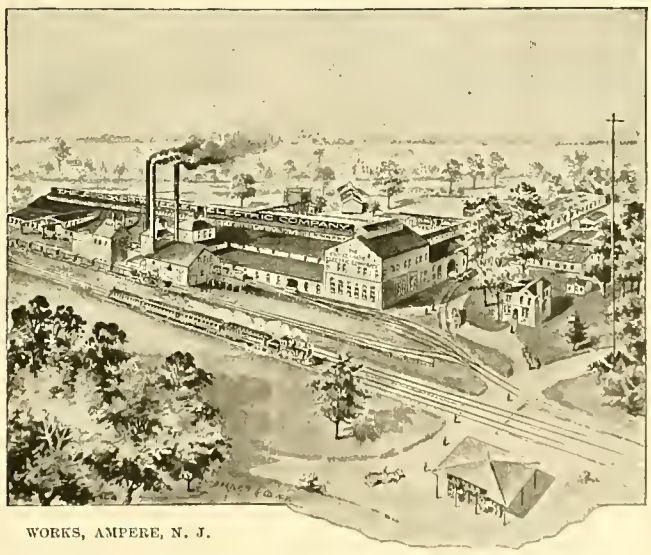

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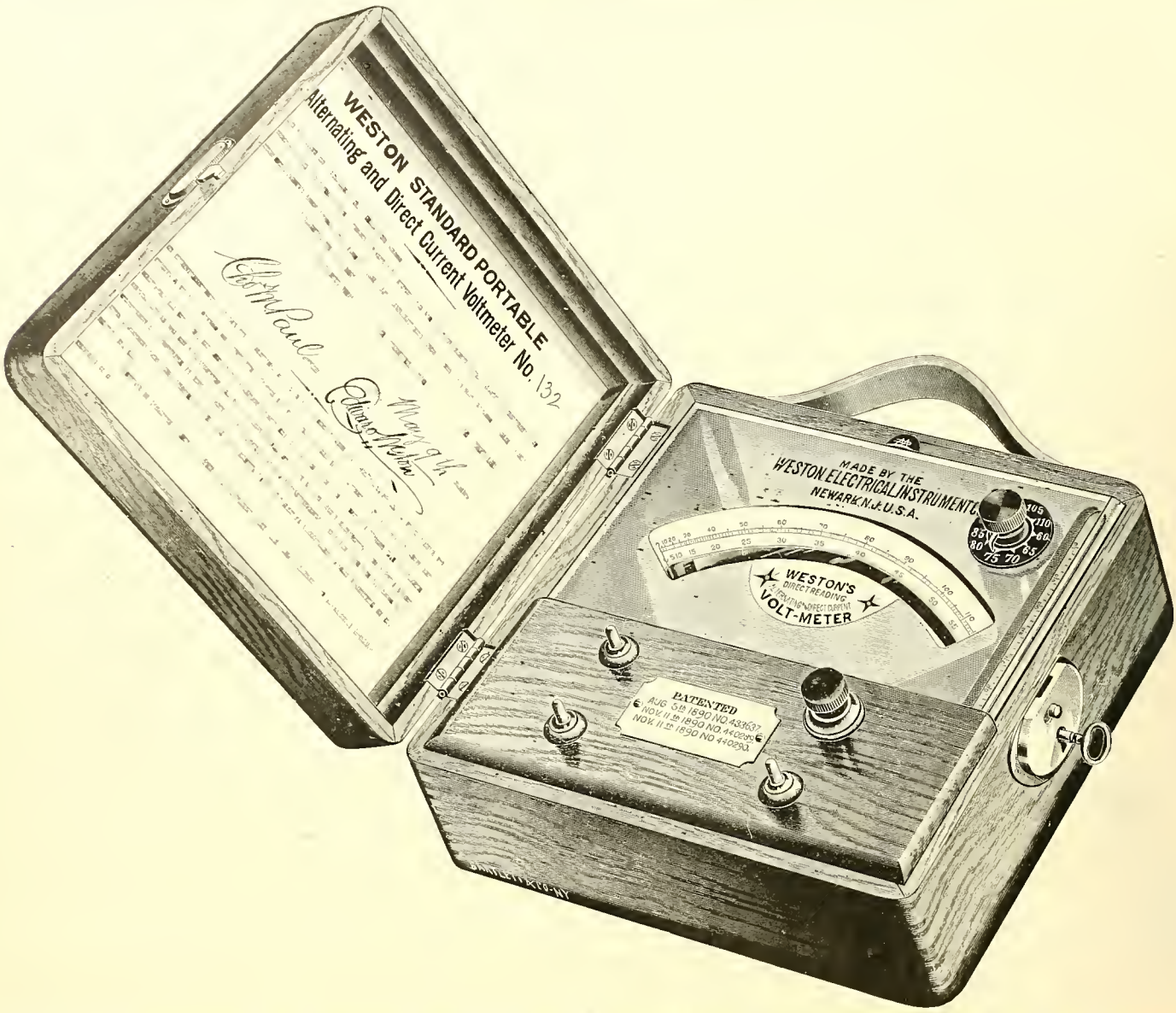

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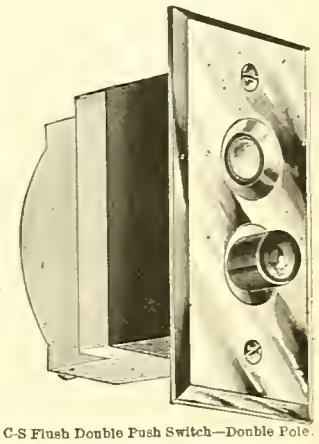
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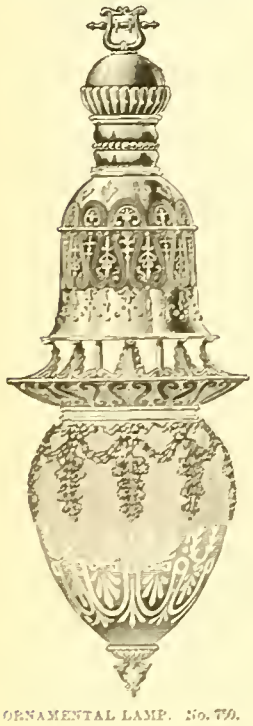

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Our Lamp is absolutely Reliable and will not change from use.

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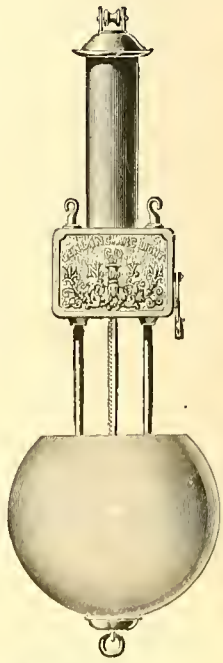

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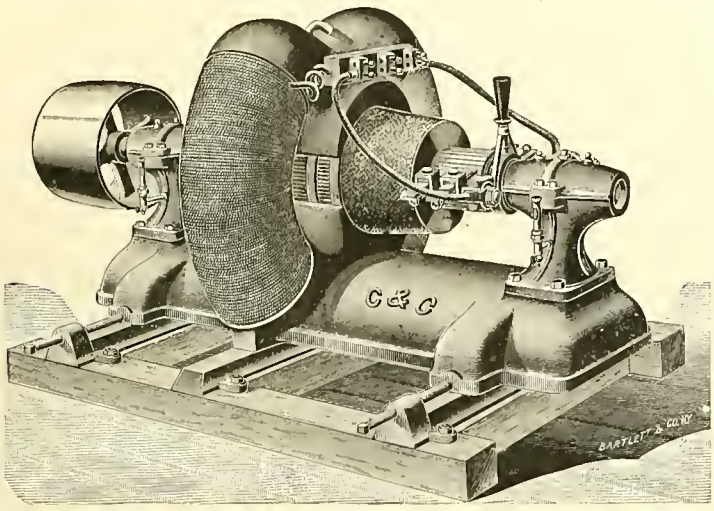

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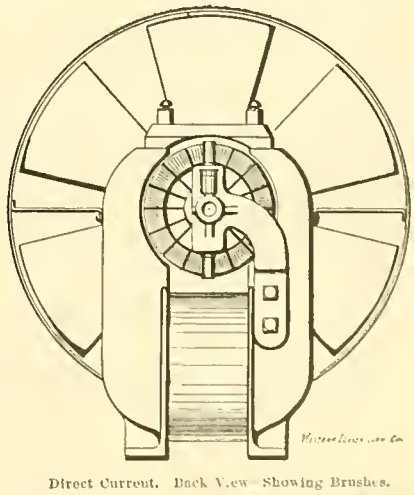

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CUSTOMERS FULLY PROTECTED FROM CLAIMS FOR INFRINGEMENT.

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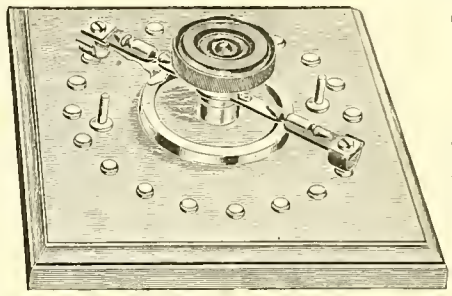
Are you a Station Manager? If so consider this.



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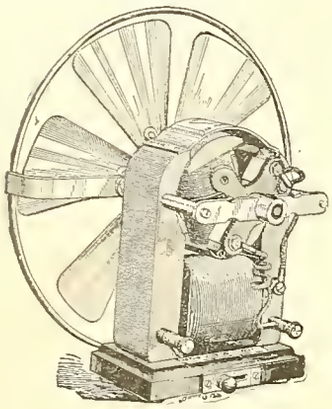

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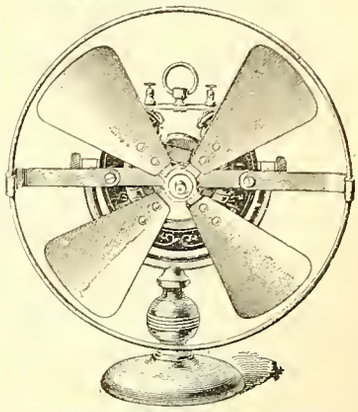

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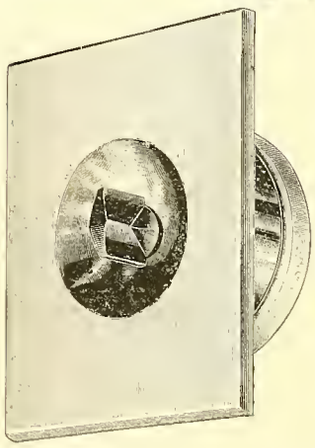

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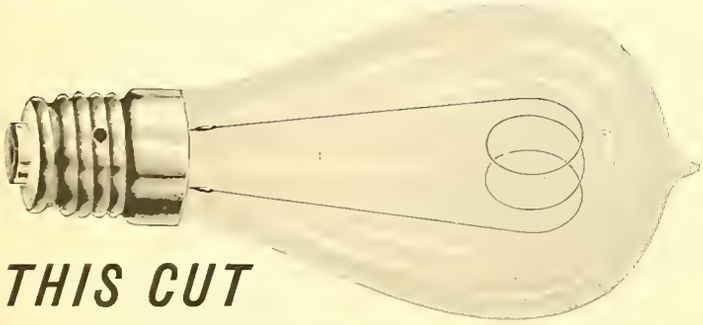

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Represents our Double Coil 32 Candle Power

"BUCKEYE" LAMP.

IT HAS NO EQUAL.

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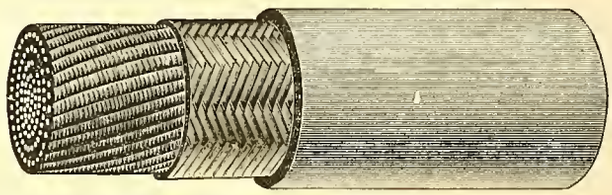
Insulated Wire

FOR ELECTRICAL PURPOSES.



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The Sawyer-Man Stopper Lamp, made by us, has now been on the market since last January, and during that time it has proved itself the best and cheapest Incandescent Lamp offered to the public.

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STANDARD SCREW GLASS INSULATORS

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BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

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To our customers and the trade in general to visit us at our World's Fair Headquarters

ELECTRICITY "U 16" BUILDING,

In the southwestern part of the gallery. *Make our space your headquarters.* You will find a place to rest yourself and

MESTON FAN MOTORS

To keep you cool.

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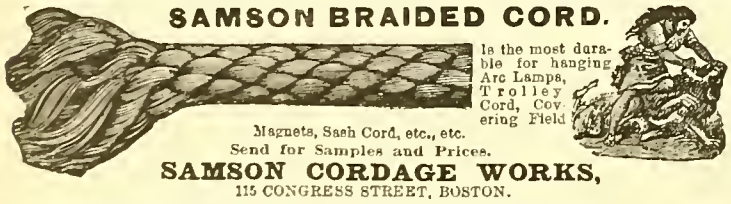

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THE ACKNOWLEDGED SUPERIOR OF ALL
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VERTICAL.

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Send for Circular and Cornell test report.

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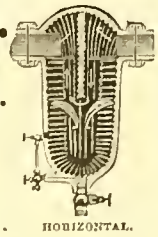
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FOR DIRECT AND ALTERNATING CURRENTS.

One-Eighth Horse Power. Twelve Inch Fan.
Self-Oiling. Constant Speed.

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We keep these motors constantly in stock, and can make very prompt shipments.

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The Wagner Alternating Current Power Motor solves the problem of how an alternating current station can run a profitable day circuit.

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The WADDELL-ENTZ COMPANY,

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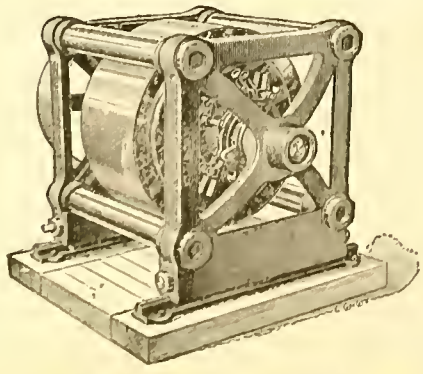

Improved Slow-Speed Generators and Motors. "DIRECT-DRIVEN" Slow-Speed Generators for Electric Lighting and Power. Low Running Expense. Insulated Wire and Flexible Cords. Estimates furnished. Isolated Plants a specialty.

PHILADELPHIA, 501 Girard Building
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WORKS AT BRIDGEPORT, CONN.

Western Electrician.

EVERY SATURDAY.

Vol. XII. CHICAGO, JUNE 24, 1893. No. 25

Electricity at the World's Fair.

Much interest has been manifested among the exhibitors in the electricity building over the controversy that has been in progress since the Westinghouse Electric & Manufacturing company began work for its large electric sign on the inside of the southern wall of the building. The opposition to the Westinghouse design came principally from the exposition representatives of the General Electric company. Up to the time that the big wall space at the southern end of the building was turned over to the Westinghouse people the General Electric company's tower of light was unquestionably the most conspicuous feature of the interior of the building. But inasmuch as the Westinghouse wall decoration takes up a semi-circular space 102 feet wide and 64 feet high and is visible from all portions of the building, with a head of Columbus 18 feet high, surrounded by an inscription in four-foot letters, the whole thickly studded with incandescent lamps, it may be easily imagined that it is in a position to challenge the question of prominence with any other feature of the building. This fact was quickly recognized by the representatives of the General Electric company, who immediately entered an emphatic protest, asserting that the design was wholly inartistic, amounting to nothing less than a disfigurement of the building, and totally out of place. These gentlemen also pointed out that although their tower of light occupied the most central position in the building they had carefully refrained from putting any sign or lettering on it, even as much as the name of Edison. To this the Westinghouse company rejoined that expositions were primarily for advertising purposes; that it had expended a large sum of money in connection with the electrical features of the fair and was entitled to as large a return in advertising as possible; that the design was not inartistic; that the wall space was assigned to it in the regular way and that, within reasonable bounds, it was entitled to make such display thereon as it saw fit. The General Electric company pressed the point, however, and endeavored to secure the removal of the lettering and lamps by all the means in its power. Chief Barrett held that the assignment was regularly made and could not be rescinded for the reason assigned. The General company carried the matter to Mr. Burnham, the director of works, who, after consultation with the exposition artists, held that the Westinghouse decoration was not in harmony with the embellishments of the building and was also an infringement of the prerogatives of the construction department as interfering with the general decorative scheme of the building. He ordered the sign removed. Chief Barrett, however, considered that Mr. Burnham had no jurisdiction in the premises, and the order was not carried out. In the meantime a petition was circulated among the exhibitors in the building praying for the removal of the sign, but it received few signatures and had no effect. The dispute was then taken before President Higinbotham, who sided with the Westinghouse company, saying that that company had rendered material service to the exposition and was entitled to all due consideration. Finally the council of administration took up the question and settled it a few days ago by deciding that the sign should remain in place. It may be added that the Westinghouse company was one of the last to commence work on its exhibit in electricity building and that, prior to that time, the space had been offered to several other companies, including the General Electric.

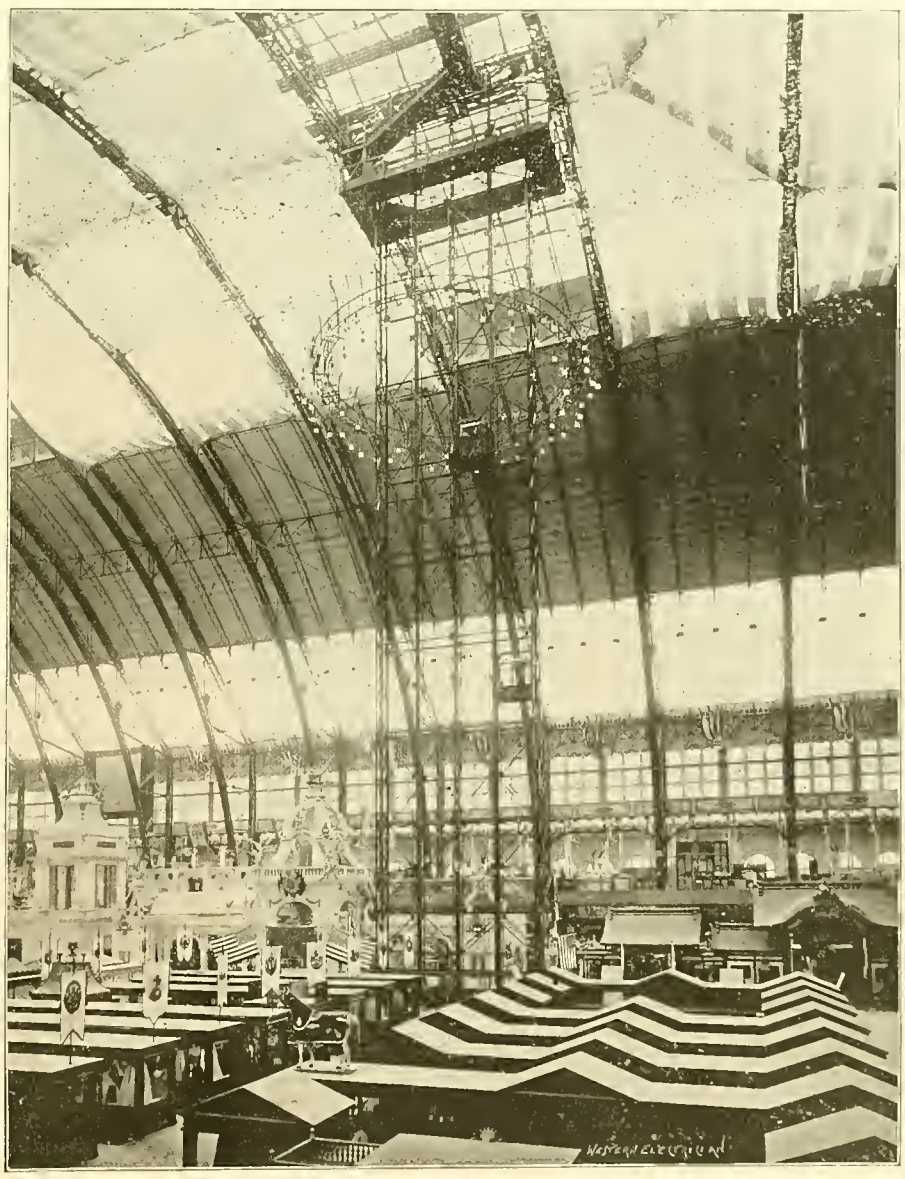

FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.—ELECTRIC ELEVATORS RISING TO A HEIGHT OF 200 FEET, MANUFACTURES BUILDING.

It is believed that the elevators illustrated in Fig. 1 are operated to a greater height than any others in the world supplied with electric power. If this is correct, and there seems no reason to doubt the accuracy of the assertion, the World's Fair adds to its list of superlative things one more in the shape of the highest-going electric elevators in the world, for the picture is a representation of a familiar feature of the great manufactures building at the exposition.

These elevators are employed to carry passengers from the floor of the building to the roof promenade above, which is a popular resort, and the distance to the landing under the great trusses supporting the roof is almost exactly 200 feet. There are four elevators, arranged in two sets, each elevator balancing one other by a continuous steel rope running over a drum above. The advantage of this arrangement is obvious, as if the weight of the loaded car going down is equal to that of the one going up, only current sufficient to overcome the friction need be supplied to the motors operating the driving drums. As a matter of fact only about four horse power is expended to hoist a loaded car to the top and bring its fellow down, and the average load on each car is from 2,000 to 2,500 pounds. The elevators are geared to run at the rate of about 200 feet a minute.

The electrical and mechanical equipment is contained in a basement room directly underneath the elevators, and a view of the mechanism operating one set of cars is shown in Fig. 2. Power is furnished by a 15 horse power, compound wound Eickemeyer motor supplied with current of 500 volts potential by mains from machinery hall. The armature shaft of the motor is supplied with a worm gearing, which meshes into a spur gear, which, in turn, is geared to the driving drum. The power is controlled by devices similar in operation to those employed in all electric elevators. When the man in charge of the car throws over the lever at starting a solenoid is released, which, by its movement, gradually cuts out the resistance and starts the motor. In stopping the process is reversed. An automatic device is provided by which the main circuit is opened in case of an accident to the shunt field, thus preventing the machine from burning out. An automatic cut-out will also be used to close the main switch in case the current from the power house should be shut off, thus protecting the machines when current is turned on again.

So far these elevators have worked very smoothly and without an accident, carrying from three to four thousand persons daily without a stop or hitch of any kind. As Fig. 1 shows, the shafts are of open iron work, and rising, as they do, from the center of the floor to a great height, many persons are nervous on making the first ascent. Those who have tried both describe the sensation as not unlike that of a balloon ascension. However, there is absolutely no ground for apprehension, as the construction is of the strongest throughout, and every precaution is taken to insure safety. The elevators were installed by the Hale Elevator company of Chicago, the electrical work being in charge of V. J. Gibson, while Peter O'Brien had charge of the mechanical construction—a

task of no mean proportions, as can be readily imagined. The same company will install electric elevators of similar type, to travel about the same distance, at Niagara Falls.

The electric launch service, under the direction of Admiral Barney, continues to give very general satisfaction to the public. On Tuesday of last week 43 boats were in service and the day's receipts amounted to $3,800. During the busiest season probably $5 000 a day will be earned by the boats. The Priocess Eulalia enjoyed several rides on the electric launches during her visit to the World's Fair and appeared greatly pleased.

The average nightly load on the Westinghouse incandescent plant in machinery hall is now 40,000 lamps on evenings when the fair is open. Nine of the big 10,000 light machines have now been operated under load. Some trouble has been experienced with the steam connections of the engines, so that the entire plant is not quite complete. A handsome iron railing has been erected about the space forming the incandescent lighting station. The operating staff is now fully organized and working smoothly. The men are divided into three shifts, each working eight hours. The lightest load is from 4 to 8 A. M., when current is supplied to about 5,000 lamps. The Westinghouse 700 horse power generator for power service is now being set up in machinery hall.

Attached to the big 1,000 horse power Buckeye engine, belted to one of the Westinghouse dynamos in machinery hall, is a model about a foot long. The little engine is an exact reproduction of the big one and is driven by compressed air. It attracts much attention.

Workmen were engaged last week in placing slag on the decks of the electric fountains about the spouts. This is in accordance with the idea of Luther Stieringer, the designer, who is now in the East.

Chief Barrett has appointed Frank G. Mason, superintendent of the Brooklyn police telegraph department, first honorary assistant of the department of electricity, World's Fair. Elliott Smith, superintendent of fire alarms, New York, and Morris Mead, city electrician of Pittsburg, have been honored in a similar manner.

Several complaints have been made of the theft of small articles in the electricity building, and so the following special notice to exhibitors, issued by Chief Barrett, is timely and important:

Exhibitors in this department will kindly impress upon their attendants the necessity of locking all desks, drawers and show cases at their exhibit spaces before leaving the building at night. Complaints have come to the department from the guard that several exhibitors have been careless in putting away small articles at night. While the guard is very efficient exhibitors will see the necessity to co-operate with it for the protection of exhibits.

The electric air compressor illustrated in Fig. 3 is an exhibit of the Westinghouse company in the electricity building. It is a queer-looking machine and is intended to furnish compressed air for use in mines or other places where electric power is available. In the present instance it will operate two Ingersoll & Sargent rock drills. The motor is of 50 horse power capacity, four pole and shunt wound for a direct current of 500 volts. The fields are supported by a solid circular casting attached to the bedplate while the armature is supported by overhanging bearings. The power from the motor is transmitted to the compressor, which is of the usual type, by gearing, in the manner illustrated in the cut.

R. W. H. Hofstede-Crull, the Dutch electrical engineer who is assistant to E. J. Spencer and in direct charge of the mining and pumping macinery in the General Electric company's exhibit in electricity building, was recently made the victim of a serious assault. Mr. Hofstede, who has long been connected with the Thomson-Houston International company, has acted as paymaster for the General Electric company's men at the fair, disbursing about $15,000 a month, and, as no provision has been made for the safe keeping of money over night in the electricity building, he has frequently been obliged to carry considerable sums on his person. This fact appears to have come to the knowledge of some desperate characters, and, as Mr. Hofstede was returning home late on Saturday night, June 3d, he was set upon by four footpads on Forty-seventh street, near Vincennes avenue. One of the men had a revolver, which he thrust in Mr. Hofstede's face, at the same time demanding that he throw up his hands and keep quiet. The muscular young Hollander did not propose to be robbed without a struggle, however, and he grappled with his principal assailant and succeeded in turning the revolver against him, but could not discharge the weapon. The other men were not idle in the meantime and a fierce struggle ensued at unequal odds during which Mr. Hofstede was so severely beaten over the head with a brick that a thick cap was probably the only thing that saved his life. He made a brave fight but was finally forced to the ground, when he raised a cry for help. His outcry was speedily hushed, however, by the grip of one of the highwaymen's fingers on his throat and he was strangled into unconsciousness. When he regained his senses he discovered that $165 in money and a valuable watch and chain had been taken from him. Fortunately the robbers overlooked, in their haste, one pocket which contained a considerable sum. The robbery was reported to the police but the perpetrators are still at large.

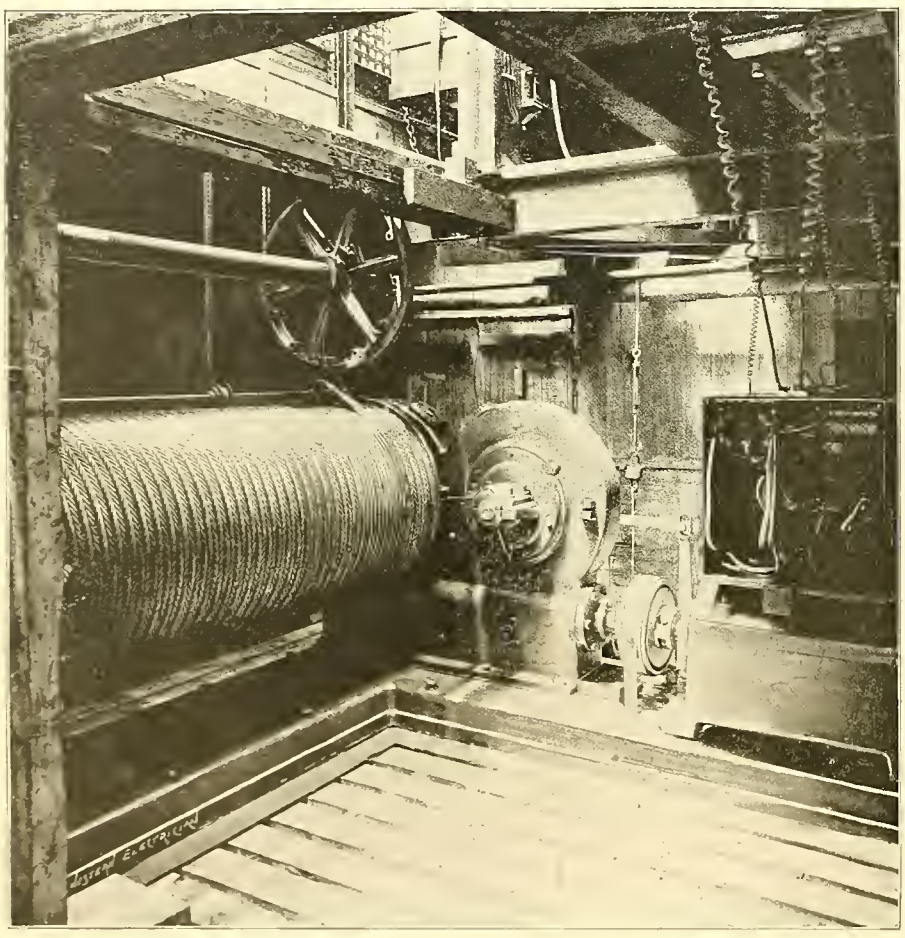

FIG. 2 ELECTRICITY AT THE WORLD'S FAIR.—ELECTRIC ELEVATOR PLANT, MANUFACTURES BUILDING.

That switches, fuse blocks and other insulating devices of porcelain are capable of lending themselves to graceful designs is conclusively demonstrated by the display made by the Bryant Electric company of Bridgeport, Conn., Fig. 4, which manages to make a striking exhibit in a small space in the southeastern corner of the electricity building. On a dark background, the lines made by the white porcelain can be seen for a considerable distance, and visitors are usually surprised, on drawing near, to find that the pretty design is made of prosaic switches. The exhibit was designed and constructed by E. R. and T. G. Grier.

The electric scenic theater which is now open to visitors on the Midway Plaisance is the same one which was exhibited by Siemens & Halske at the Frankfort electrical exhibition of 1891 and which excited much attention. At Chicago the spectacle is in charge of Arthur Schwarz, who has a concession by which he is permitted to charge visitors a small fee for the privilege of witnessing the beautiful effects produced. The spectator is ushered into an audience room shut out from the daylight but lighted from a handsome electrolier. The objects of interest are a miniature stage in front of the spectators, who are seated in comfortable chairs, and the regulating mechanism by which the operator manipulates the light. Presently the lights are turned off and all eyes are directed toward the little stage. The curtain is raised but at first nothing is visible. Then a point of red light is seen, which gradually increases in volume until the spectator becomes aware that it is the peak of a lofty mountain kissed by the first rosy flush of the morning sun. As the sun rises the light becomes stronger and gradually loses its ruddy tinge until the whole scene is bathed in the light of day. It can then be seen that a valley in the Alps is represented, with towering peaks and a mountain torrent in the foreground surrounded by lofty crags, amid which is perched a picturesque Swiss chalet. As the spectator is admiring the landscape it grows darker; evidently the sky is overcast with clouds. A storm rapidly comes up, with sheets of lightning and the rumbling of thunder. It is of short duration, however, and presently the sky is clear again. But the day is drawing to a close and soon the failing light and brilliant hues of sunset signalize the departure of the orb of day. But darkness is not long triumphant, for presently the moon rises, and, in its journey from the horizon to the zenith, amid a field of twinkling stars, casts a clear bluish-white light over all. This is the last scene, and the disappearance of the moon is the signal for a falling curtain and the relighting of the auditorium. About fifteen minutes elapses in the "day" that is presented to the spectator. The various effects are very pretty and they elicit general praise.

The mechanical apparatus is not particularly complicated. The light is produced by a large number of 5 candle power lamps, red, white and blue in color and arranged alternately. Each color and each locality in the setting is wired on a separate circuit, so that, by the introduction of resistance, it only becomes a question of skillful manipulation to give light of any shade or intensity desired. Of course none of the lamps are visible, as they are arranged in the footlights and wings as well as overhead and behind the setting. The motion of the moon is produced by a tiny motor. Current of 150 volts pressure is used, obtained from a 500 volt circuit from machinery hall and transformed down.

In general the exhibits in electricity building well befit their location and contribute to the success of the electrical display. Exception should be made, however, in the case of the French musical instruments shown in the northwestern gallery. These are entirely out of place and should have been placed in the musical section of the manufactures building. The incongruity of thrusting this exhibit in the electricity building is marked, and while not the fault of the department of electricity or the exhibitor in question it excites remark from visitors. The exhibit includes a number of mechanically operated pianos and several gaudy orchestrions. The latter are "played" by two sturdy French girls by the simple process of turning a crank, and the sounds produced are so harsh and loud that near by exhibitors are anxiously casting about for some means of relief.

On Monday the council of administration took action that will be received with rejoicing by every electrical exhibitor at Jackson Park. This was an order throwing open the grounds to the public on every evening until 11 P. M. The buildings are to be open until ten o'clock, and the order went into effect on Wednesday. The order in full is as follows:

The council having for some time had under considera-

tion the question of keeping the exposition open on every evening, and having ascertained from practical tests that the public desires to be accommodated in this behalf, and the council recognizing its duty to respond to the public demand, it is

Ordered, that on and after June 21, 1893, until otherwise ordered by this council, the exposition grounds shall be open to the public on every evening until 11 P. M. and that the exposition buildings shall be kept open until ten o'clock. It will be expected that visitors will promptly leave the exposition buildings at ten o'clock, and also promptly leave the exposition grounds at eleven o'clock; and in order to facilitate their exit from the grounds it is

Ordered, that promptly at eleven o'clock on each evening the wagon gates at the several exits shall be opened for purposes of exits; and it is further

Ordered, that while the exposition will be open as herein provided for on every evening of the week, Tuesday, Thursday and Saturday evenings shall be nevertheless regarded as special evenings, and characterized by special features of attraction and entertainment.

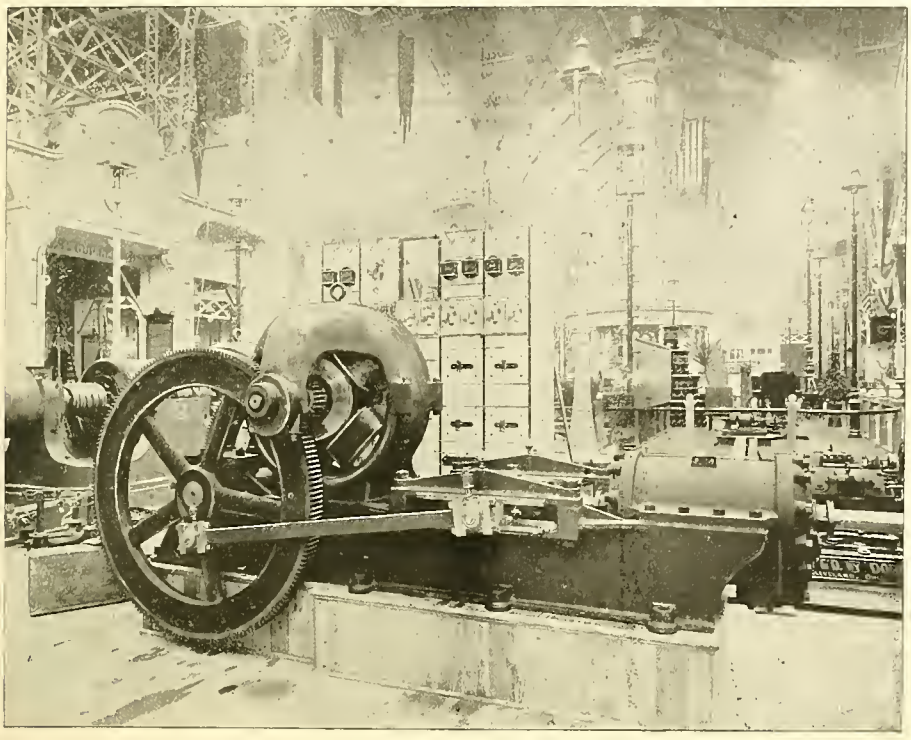

FIG. 3. ELECTRICITY AT THE WORLD'S FAIR.—ELECTRIC AIR COMPRESSOR, ELECTRICITY BUILDING.

Street Railway Controversy in San Francisco.

San Francisco, not to be outdone by the older cities of the country in the matter of unreasonableness in its estimation of trolley circuits for street railway use, is now engaged in the throes of a bitter controversy, that has at this early stage reached the courts.

The first act in this drama occurred on May 29th at midnight, when the Omnibus Cable company, which has recently secured controlling interest in the North Beach & Mission Railway company, appeared on Market street, San Francisco's principal thoroughfare, with an army of men, estimated by the *San Francisco Chronicle* as reaching 2,000. Immediately following appeared scores of trucks loaded with shovels, barrels of concrete, electric trolley poles, immense reels of wire, hangers, cross-wires, etc., and all other paraphernalia necessary for the complete equipment of a trolley system.

The army started to work and in a short time the men were digging holes along the curbs and planting poles. After about two hours' work, Mayor Ellert appeared upon the scene and commanded that the work should cease, maintaining that the company had no franchise granting it the privilege of placing trolley circuits upon Market street. To this request the Omnibus people, through their attorneys, Wood & Herrin, complied; the work ceased and the army was disbanded, but twenty or so railway poles stood as a monument of the midnight adventure. In these, however, Mayor Ellert recognized a vantage point that he did not propose, as the chief executive of the city, to tolerate; consequently the street department was called to the rescue, a derrick was rigged up and the poles were pulled out of their holes and carted to the corporation yard.

San Francisco papers were filled with accounts of how the rights of the city were being trampled upon by private corporations. The legality of the action was maintained by the attorneys of the Omnibus Cable company, and the city authorities were equally strong in maintaining that the attempt to place poles on Market street was unwarranted. The mayor's action was warmly endorsed by the papers, but, regardless of conflicting opinions, the Omnibus Cable company has brought suit against the mayor, the chief of police and the superintendent of streets, in the Superior Court, to enjoin the city officials from interfering with the erection of the trolley system.

Until the recent consolidation of the Omnibus Cable company and the N. B & M. Railway company, there was no continuous franchise for a street car line on Market street from Eighth street to the ferries, other than that owned and occupied by the Market Street Cable company. On each side of the center tracks occupied by the Market Street Cable company horse car tracks existed over the route named, but the tracks were owned by different companies who jointly occupied them, yet who held different franchises. When the consolidation referred to was effected, the Omnibus Cable company won a continuous line from Eighth street to the ferries, and it was this system that it intended to operate by electricity.

The legal situation appears to be about as follows: At the last session of the Legislature a law was enacted to the effect that franchises which had been granted for street railway privileges prior to the enactment of the law in question would be made to cover electricity as a motive power on an equal footing with horse or cable traction, provided that municipal requirements should be complied with. Since the abrogation of the order of the board of supervisors, prescribing a district in the business center of San Francisco in which the use of overhead trolley circuits should be prohibited, there has been no municipal enactment restricting the use of the trolley system in the city; and it is believed that this point is the principal one upon which the Omnibus Cable company will make its fight.

The law reads, however, that electric railway systems in cities shall be provided with the most modern improved electrical appliances, and the mayor maintains that the trolley system does not constitute the most modern improved electrical appliance. He firmly believes that underground or storage systems are practicable and safe, and that therefore a conformity with the law can only be had through the equipment of either an underground or a storage system.

It was felt during the fight over the attempt to introduce the trolley system on Market street that the subtle hand of the Southern Pacific company, through its principal San Francisco concern, the Market Street Cable company, was at the bottom of the opposition which succeeded in pulling up the poles that the Omnibus Cable company had placed. Mayor Ellert has, however, shown himself to be beyond the influence even of the power of the Southern Pacific company in a subsequent occurrence in which the Market Street Cable company itself was the aggressor, and in which the tactics originally laid out and which failed with the Omnibus Cable company on Market street, were followed almost to the letter.

The Market Street Cable company holds the franchise for the building of an electric road on Seventh street, and on the morning of June 8th laborers appeared on Seventh street and commenced the erection of poles for a trolley road. Poles were placed on Seventh street, between Market and Mission streets, whereupon the laborers moved bag and baggage to Fifth street, and there commenced the erection of poles for the equipment of the Fifth street branch of the Market street system. After a number of poles had been placed, the mayor appeared and not only put a stop to the work, but pulled up the poles the Market Street Cable company had placed, both on Fifth and Seventh streets, and carted them off to the corporation yard, placing

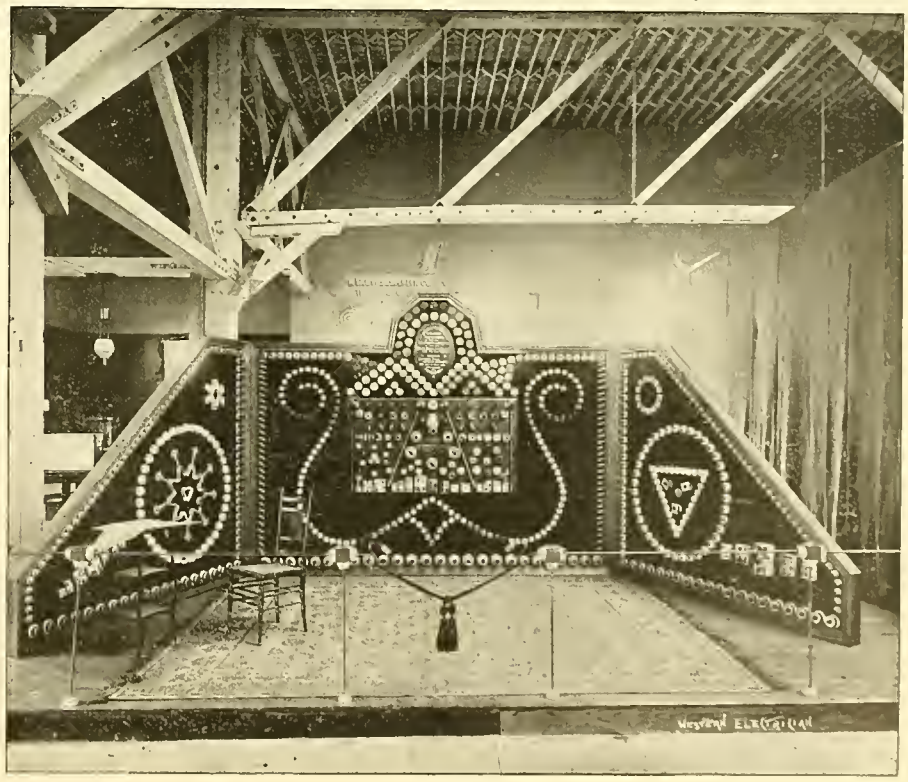

FIG. 4. ELECTRICITY AT THE WORLD'S FAIR.—EXHIBIT OF THE BRYANT ELECTRIC COMPANY, ELECTRICITY BUILDING.

them alongside of those of the most formidable rival of the Market Street Cable company—the Omnibus Cable company. There are, therefore, 22 more poles in the corporation yard than before the last escapade of the Market Street Cable company.

The situation of the Market Street Cable company on Fifth street is precisely identical with that of the Omnibus Cable company on Market street, and the franchise of neither company permits the use of electricity as a motive power, each company working under the recently enacted state law. On Seventh street, however, a franchise for an electric road is held by the Market Street Cable company, but the contention of the mayor is that the clause in the franchise providing for the use of the most modern electrical appliances in the equipment of the road is not complied with in the trolley system.

The suit of the Omnibus Cable company against the city officials is at present pending before Judge Garber of the Superior Court, and there seems to be a general disposition, not only on the part of the railroad companies interested, but also on the part of the municipal officers, to let the decision of the courts settle the matter. The railway people feel that they have an invincible case, and that if the suit is not won in the lower courts, it will certainly be decided in their favor in the upper tribunals.

World's Congress of Electricians.

Prof. H. S. Carhart, secretary of the World's Congress of Electricians, announces the following acceptances of invitations to read papers at the congress:

W. H. Preece, F. R. S., engineer-in-chief, General Postoffice, London. Subject—"Signalling Through Space by Means of Electromagnetic Vibrations."

Professor W. E. Ayrton, F. R. S., City and Guilds of London Institute, Central Institution. Subject—"The Variation of P. D. of the Electric Arc with Current, Thickness of Carbons and Distance Apart."

Professor Mascart of Paris will be present but is obliged to decline to prepare a paper by reason of other engagements. Both the war and navy departments have detailed officers to attend the congress. Professor Ayrton sails from Liverpool June 21st, and expects to be in Chicago by July 1st or 2d.

The question is being agitated at Crowley, La., of putting in an electric light plant to be operated in connection with the waterworks.

Ifaddon & Co., Glasgow, have just completed a new installation of electric light on board the steamship City of Rome. The plant consists of two compound wound dynamos of the Castle type, having an output equal to 500 16-candle power incandescent lamps. The main switchboard is of their own design and manufacture, and is a simple but efficient arrangement whereby, without any possibility of confusion, any division of the lights can be run by either of the machines. The installation is giving every satisfaction, and is said to be a marked advance upon the previous lighting.

New Chicago Office of the Western Union Telegraph Company.

The Western Union Telegraph company has transferred its Chicago main office, operating department and general offices from its old quarters in the Union building at the corner of La Salle and Washington streets to its new building on the corner of Clark and Jackson streets. This building was formerly known as the Phenix building, is absolutely fire proof, and was purchased by the Western Union company last October. From an architectural standpoint the building is one of the very best in Chicago and there are but few better in the country. The additional story, together with the new roof elevation, will add much to the appearance of the property and give it rank as one of Chicago's finest office buildings. In dimensions it is 217 feet long by 50 feet wide, fronting on the three thoroughfares: Clark and Jackson streets and Pacific avenue. The finish of the building is elegantly done in white marble and solid mahogany, every office is well lighted, and five elevators, now being refitted, make the elevator service second to none in the city for rapidity and safety.

For its own use the telegraph company will occupy five floors of the building as follows—the west half of the cellar for its dynamo and terminal rooms; the west half of the first floor, on Pacific avenue and Jackson street, for its receiving, delivery and money order departments, the entire eighth floor for its general offices, the ninth and tenth floors for its operating departments, the attic, or eleventh floor, to be used for dining room, clothing lockers, lavatories, etc.

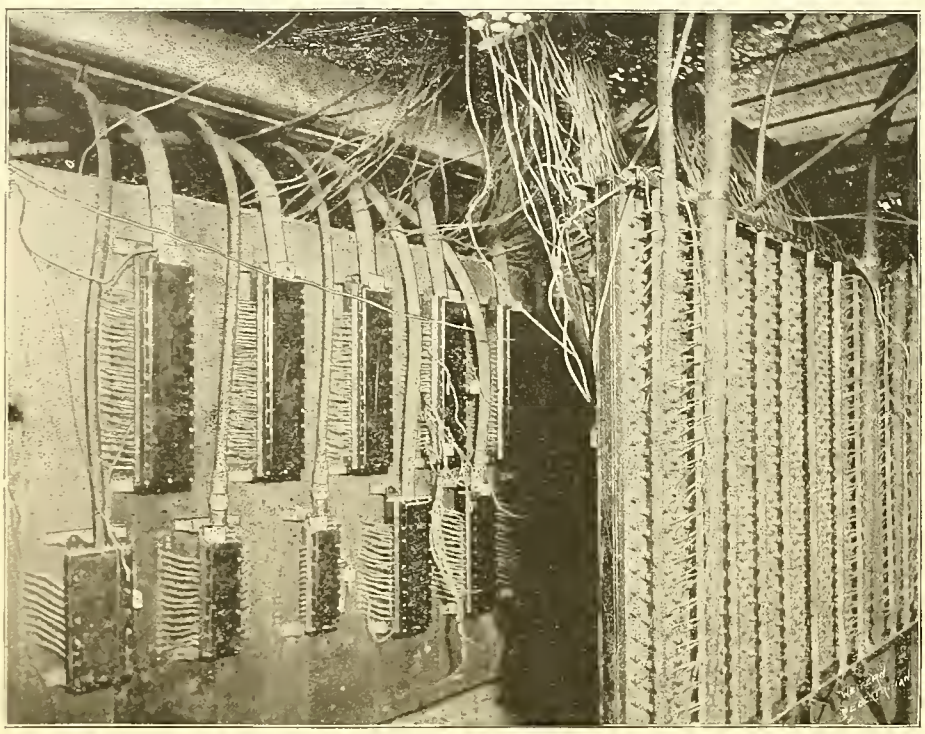

FIG. 2. NEW CHICAGO OFFICE OF THE WESTERN UNION TELEGRAPH COMPANY.—TERMINAL ROOM.

In the dynamo room will be found a first class piece of wire work. There are in all 47 dynamos, two groups of eight each, one reversible group of five, and 26 small dynamos for use as intermediates on short wires. The principal problem was to carry the wires from the dynamos to the dynamo switchboard in the east end of the dynamo room without crossing any two of the leads. This was no easy task when the multitude of wires is taken into consideration but it was finally successfully accomplished. All the negative cables are grouped together on one side of the board and all the positive cables on the other. All the dynamos are of the Edison type, excepting two Crocker-Wheeler dynamos, which have been added to the station since its removal ftom the old building. Weston direct reading voltmeters are also in use. These 47 dynamos generate all the power that is used for transmitting and operating in the building. It would take 33,000 cells to replace their electrical energy. The seven-volt dynamos operate the single wires and repeating sounders, the 25 volt machines supply the duplex and quadruplex local wires, the 45 volt the short city lines, and the 75, 150, 210, 290 and 350 volt, the single, duplex and quadruplex wires, according to length and resistance. The 26 small dynamos are used on city lines. The illustration, Fig. 1, gives a good idea of the dynamo room, the small dynamos being to the left and the switchboard at the extreme end.

Northwest of the dynamo room will be found the terminal room, where may also be seen an admirable arrangement of wires, cables, cable terminals and slate boards, the cables passing from the underground conduit to the terminals, thence to the front of the slate board, and from the rear of thes late board to the twenty-two 100 conductor cables leading to the various switchboards in the operating departments through the 3 inch iron pipes which begin in the terminal room, pass into concrete beds under the massive pumping machinery of the building, and thence upward to the operating room. In the illustration, Fig. 2, the slate board, consisting of two sections of slate, each section possessing 300 binding posts, is shown on the right, overhead and back of which is a conglomerate mass of cables as yet unattached to the terminal heads. On the left is shown some of the terminal heads which are now wired. In this room the wiring is not yet completed and some idea of the extent of the task may be gained by glancing at the loose cables at the top of the picture. When completed there will be 28 cable terminal heads, each box containing 19 to 200 conductors. From the terminal room to the operating room there run in all 25,000 single wires, 14,000 two conductor cables, 20,000 four conductor cables, 3,600 eight conductor cables, 6,100 ten conductor cables and 22 one hundred conductor cables. Day's kerite insulation is used exclusively.

The receiving, money order and delivery department is superb in its mahogany finish and is altogether different from the old style telegraphic counter, the writing desks for patrons being located in the deep recesses of the large windows and arranged for chairs instead of the old style standing desk so long used for the purpose. On the inside of the counter the various departments are divided by a series of polished brass screen cages and present a handsome banking house appearance.

The most interesting room in the building, however, is the ninth floor operating room. This room is 22 feet in height, running the full length of the building, is well lighted on all sides, tile floored, well ventilated and admirably arranged. On the south wall, and east of the elevator shaft, is the eastern switch of five sections with fifty wires to the section. In the same relative position on the west is the western switch with like capacity, and on the tenth floor will be placed the city line switch of three 50 wire sections. In the center of the room, in the large bay window on the north wall, is located what is known as the combination switch, made after the pattern of the one in the New York main office. To this switch is run all of the quadruplex local wires of the office and through it can be connected all of the various branch offices, such as the Board of Trade, Grocery District, etc. Entering at this board are all of the newspaper loops, and running thence to the east and west switches are what may be called flying loops, arranged so that if Denver has a Chicago newspaper special and New York also has one, they are for the time transferred to the combination board and from that point the newspaper is given its connection.

The wire work of the dynamo room was designed by Louis Seibel, wire chief of the Cleveland office; that in the terminal room by J. S. Robinson, foreman of repairs, and that in the operating room by V. T. Kissenger, wire chief of the Chicago office; the whole being under the supervision of C. H. Summers, electrician of the company at Chicago.

The operating departments are fully equipped with the Martin cash carrier system, and there is nothing which will more interest the casual visitor to the great operating department than this system. From the distributing table in the gallery of the ninth floor dropping to the operating level below, running to the floor above, around the corners, on the diagonal, taking angle elevation and decline alike, run the sixteen tracks of this unique little railroad, and hurrying, scurrying hither and thither are the tiny cars in such number and bewilderment that one is at once reminded of a busy railroad switching yard.

An excellent idea is given of the different interesting features of this room in Fig. 3. Here on the ninth floor are operating spaces for 460 machines. In the gallery 92 city lines are in operation, and it is expected that by August the tenth floor operating room will be opened, which will accommodate nearly as many more. Here also will be located the company's corps of bookkeepers and the Wheatstone system of automatic telegraphy. These rooms to the visitor present scenes of continual bustle and confusion, and one cannot but wonder at the acute ear of the operator who can detect the sounding of his own instrument amid the constant and bewildering, clicking of over 640 sounders. The room as

yet is in an unfinished condition and much in the way of decoration and comfort is yet to be provided.

The Chicago office enjoys the distinction of having more complete facilities for the quadruplex system of sending messages than the New York office. One of the novel features noticeable in the operating rooms is the enclosing of the switchboards in plate glass with iron frames. This idea was copied from the New York main office and gives the switchboards a unique and handsome appearance. In all there are 14 switchboards in the building and 3 loop switchboards, each with five rows of jacks.

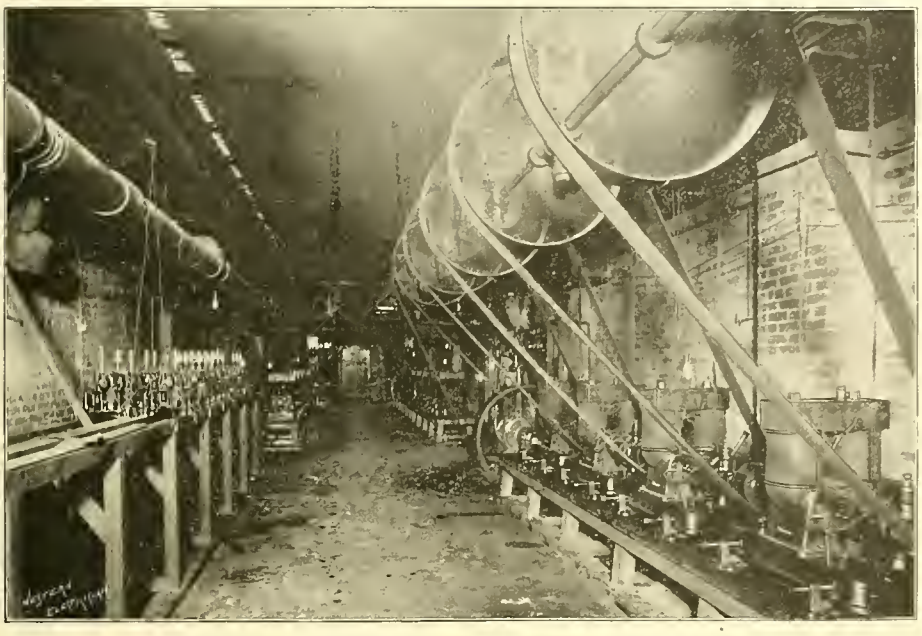

FIG. 1. NEW CHICAGO OFFICE OF THE WESTERN UNION TELEGRAPH COMPANY.—DYNAMO ROOM.

There are in use 2,826 resistance lamps, varying from 20 to 700 ohms. This number has been found to be insufficient, however, and several hundred more are to be added.

For the admirable arrangement of the building and the diminution of time in the transfer of telegrams effected by it, for the general telegraphic equipment, first-class in all respects, and for the handsome receiving room offered to the patrons of the company, Chicago is indebted to the Western Union Telegraph company, in that it now has a telegraph office second to none in the world.

Light and Other High Frequency Phenomena.

By Nikola Tesla.

PART IV.

The effects of resonance are being more and more noted by engineers and are becoming of great importance in the practical operation of apparatus of all kinds with alternating currents. A few general remarks may therefore be made concerning these effects. It is clear that if we succeed in employing the effects of resonance practically in the operation of electric devices the return wire will, as a matter of course, become unnecessary, for the electric vibration may be conveyed with one wire just as well, and sometimes even better than with two. The question first to answer is, then, whether pure resonance effects are producible. Theory and experiment both show that such is impossible in nature, for as the oscillation becomes more and more vigorous the losses in the vibrating bodies and enviroring media rapidly increase and necessarily check the vibration, which otherwise would go on increasing forever. It is a fortunate circumstance that pure resonance is not producible, for if it were there is no telling what dangers might not lie in wait for the innocent experimenter. But to a certain degree resonance is producible, the magnitude of the effects being limited by the imperfect conductivity and imperfect elasticity of the media or, generally stated, by frictional losses. The smaller these losses, the more striking are the effects. The same is the case in mechanical vibration. A stout steel bar may be set in vibration by drops of water falling upon it at proper intervals; and with glass, which is more perfectly elastic, the resonance effect is still more remarkable, for a goblet may be burst by singing into it a note of the proper pitch. The electrical resonance is the more perfectly attained, the smaller the resistance or the impedance of the conducting path and the more perfect the dielectric. In a Leyden jar discharging through a short stranded cable of thin wires these requirements are probably best fulfilled, and the resonance effects are therefore very prominent. Such is not the case with dynamo machines, transformers and their circuits, or with commercial apparatus in general in which the presence of iron cores complicates or renders impossible the action. In regard to Leyden jars with which resonance effects are frequently demonstrated, I would say that the effects observed are often attributed but are seldom due to true resonance, for an error is quite easily made in this respect. This may be undoubtedly demonstrated by the following experiment. Take, for instance, two large insulated metallic plates or spheres which I shall designate A and B, place them at a certain small distance apart and charge them from a fractional or influence machine to a potential so high that just a slight increase of the difference of potential between them will cause the small air or insulating space to break down. This is easily reached by making a few preliminary trials. If now another plate—fastened on an insulating handle and connected by a wire to one of the terminals of a high tension secondary of an induction coil, which is maintained in action by an alternator (preferably high frequency)—is approached to one of the charged bodies A or B, so as to be nearer to either one of them, the discharge will invariably occur between them, at least it will, if the potential of the coil in connection with the plate is sufficiently high. But the explanation of this will soon be found in the fact that the approached plate acts inductively upon the bodies A and B and causes a spark to pass between them. When this spark occurs, the charges, which were previously imparted to these bodies from the influence machine, must needs be lost, since the bodies are brought in electrical connection through the arc formed. Now this arc is formed whether there be resonance or not may now be connected to one of the coatings of the second jar, and when it is brought near to the first jar just previously charged to a high potential from an influence machine, the result is the same as before, and the first jar will discharge through a small air space upon the second being caused to discharge. But both jars and their circuits need not be tuned any closer than a basso profundo is to the note produced by a mosquito, as small sparks will be produced through the air space, or at least the latter will be considerably more strained owing to the setting up of an alternating electromotive force by induction, which takes place when one of the jars begins to discharge. Again another error of a similar nature is quite easily made. If the circuits of the two jars are run parallel and close together, and the experiment has been performed of discharging one by the other, and now a coil of wire be added to one of the circuits whereupon the experiment does not succeed, the conclusion that this is due to the fact that the circuits are now not tuned, would be far from being safe. For the two circuits act as condenser coatings and the addition of the coil to one of them is equivalent to bridging them, at the point where the coil is placed, by a small condenser, and the effect of the latter might be to prevent the spark from jumping through the discharge space by diminishing the alternating electromotive force acting across the same. All these remarks, and many more which might be added but for fear of wandering too far from the subject, are made with the pardonable intention of cautioning the unsuspecting student, who might gain an entirely unwarranted opinion of his skill when seeing every experiment succeed; but they are in no way thrust upon the experienced as novel observations.

In order to make reliable observations, of electric resonance effects it is very desirable, if not necessary, to employ an alternator giving currents which rise and fall harmonically, as in working with make and break currents the observations are not always trustworthy, since many phenomena, which depend on the rate of change, may be produced with frequencies widely different. Even when making such observations with an alternator one is apt to be mistaken. When a circuit is connected to an alternator there are an infinite number of values for capacity and self-induction which, in conjunction, will satisfy the condition of resonance. So there are in mechanics an infinite number of tuning forks which will respond to a note of a certain pitch, or loaded springs which have a definite period of vibration. But the resonance will be most perfectly attained in that case in which the motion is effected with the greatest freedom. Now in mechanics, considering the vibration in the common medium—that is, air—it is of comparatively little importance whether one tuning fork be somewhat larger than another, because the losses in the air are not very considerable. One may of course inclose a tuning fork in an exhausted vessel and by thus reducing the air resistance to a minimum obtain better resonant action. Still the difference would not be very great. But it would make a great difference if the tuning fork were immersed in mercury. In the electrical vibration it is of enormous importance to arrange the conditions so that the vibration is effected with the greatest freedom. The magnitude of the resonance effect depends, under otherwise equal conditions, on the quantity of electricity set in motion or on the strength of the current driven through the circuit. But the circuit opposes the passage of the currents by reason of its impedance,

FIG. 3. NEW CHICAGO OFFICE OF THE WESTERN UNION TELEGRAPH COMPANY.—OPERATING ROOM.

But even if the spark would not be produced, still there is an alternating electromotive force set up between the bodies when the plate is brought near one of them; therefore the approach of the plate, if it does not always actually, will, at any rate, tend, to break down the air space by inductive action. Instead of the spheres or plates A and B we may take the coatings of a Leyden jar with the same result, and in place of the machine, which is a high frequency alternator preferably, because it is more suitable for the experiment and also for the argument, we may take another Leyden jar or battery of jars. When such jars are discharging through a circuit of low resistance the same is traversed by currents of very high frequency. The plate and, therefore, to secure the best action it is necessary to reduce the impedance to a minimum. It is impossible to overcome it entirely, but merely in part, for ohmic resistance cannot be overcome. But when the frequency of the impulses is very great the flow of the current is practically determined by self-induction. Now, self-induction can be overcome by combining it with capacity. If the relation between these is such that at the frequency used they annul each other, that is, have such values as to satisfy the condition of resonance and the greatest quantity of electricity is made to flow through the external circuit, then the best result is obtained. It is simpler and safer

(Continued on page 327).

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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VISITORS

To the World's Fair are requested to forward their addresses to the WESTERN ELECTRICIAN as early as possible or notify us immediately upon their arrival in Chicago.

SAN FRANCISCO, like many other cities that have failed to take advantage of the improvements in rapid transit methods afforded by the trolley system, is now desirous of introducing a modern system of transportation, and the local street railway companies have signified their willingness to equip the existing horse car lines and the proposed extensions. The people favor the electric railway and the companies are willing to improve the service. In fact two of the local companies have attempted to equip their lines but have been stopped by the mayor. That official is opposed to the trolley system and seems anxious to force the companies to experiment with the storage battery and underground systems. This they refuse to do, and the controversy will be settled in the courts. In the meantime San Francisco will be obliged to put up with horse cars.

COMPLAINTS against the trolley system have been based largely upon the number of accidents that have followed the substitution of the electric motor for the horse car. It is true that a large percentage of these accidents are due to the carelessness of the victims, yet the fact remains that some of them are due to the men in charge of the cars. The public holds the company responsible for all accidents no matter how much care has been exercised in the selection and instruction of the men employed. In some cities a regular course of training has been developed by the electric railway companies, and an applicant for a position as motorman is obliged to serve an apprenticeship before taking charge of a car. Inspectors and instructors accompany new men until they are thoroughly capable of handling the cars themselves. It would seem that when such precautions were taken there should be very little cause for complaint but it appears that despite the efforts of the company and the vigilance of the inspectors the men grow careless at times and accidents occur, for which the corporations are held legally responsible. Several actions having been instituted against the street railway company of Minneapolis and St. Paul, President Lowry has determined to make the men assume their share of the responsibility. Accordingly a contract was prepared with this view and submitted to the men. Among the provisions of the contract were these: The men should be responsible not only for breakage to the cars and equipment, but to vehicles broken in collisions and personal injury sustained by passengers when such collisions and accidents were due to the negligence or carelessness of employes. The contract also provided that each employe should place with the company $100 upon beginning work, which amount should be used in paying for any accidents due to the employe's carelessness. This of course did not please the motormen, and on last Sunday morning a strike was ordered. The cars of the entire system were tied up, and the company was informed that they would remain tied up until the contract was rescinded. It is interesting to note the comments of the patrons of the road on this action. Very few recognize the right of the company to protect itself, although they demand first-class service. It is hardly possible that the company could enforce the terms of the agreement, but the incident has furnished another example of the perversity of the general public. Instead of giving the company credit for endeavoring to secure for its patrons improved service and protection against the negligence of irresponsible employes, the public generally allowed its petty inconvenience to count for more than the issue involved. The quickest way to settle the dispute was to support the men and this they did.

IT is with great gratification that the WESTERN ELECTRICIAN announces to the electrical fraternity that the management of the World's Fair has at last seen its way to the opening of the exposition on every evening of the week. The decision was arrived at on Monday of this week, and the full text of the order is printed elsewhere in this issue. This order, of course, nullifies the obnoxious evening closing rule which aroused such a unanimous protest from the men engaged in furthering the electrical industry, as the result of the agitation led by the WESTERN ELECTRICIAN The first gun in this campaign, it will be remembered, was fired by this journal on November 5, 1892, when we said, in a leading editorial:

> If this new regulation be allowed to stand, it will interfere very seriously with the electrical features of the exposition—just the extent, indeed, which separates a brilliant success from a commonplace performance. The electrical men, who are now so enthusiastically supporting the fair and contributing their skill, time and money, will lose heart and have little more than a perfunctory connection with an enterprise in which such a conspicuous disregard of their claims is shown. They have been led to believe that the fair was to be open evenings, and it is unfair and unjust to deprive them, at this late day, of the benefit the exposition would be to them as an object lesson to all the nations of the earth of the latest advances in electric lighting. * * * The electrical industries are alive to the importance of this question and will not rest content until the injustice is righted. Even now a movement is on foot to convince the commission that it has dealt a blow not only to the electrical interests of the United States, but, unwittingly, to the World's Columbian Exposition as well. That this is the case there can be no doubt, and all possible influence must be brought to bear on the commissioners to enable them to see the folly and wrong of their amazing seven o'clock rule.

The position thus taken was cordially indorsed by the electrical fraternity of the country, and the protest was so vigorous and unanimous that on November 26th the WESTERN ELECTRICIAN was enabled to announce that President Higinbotham, in response to a petition forwarded through Col. Clowry, conceded that evening sessions would be held on from three to six days each week. The fight was kept up for some time longer, but no more definite pledge from the World's Fair management could be secured. Shortly after the fair was opened it was announced that the grounds would be open on Tuesday, Thursday and Saturday of each week, and on June 19th the final and complete concession was made.

Never has the electrical fraternity receded from the position that evening opening was demanded by the public, profitable to the Exposition company and only just to the electrical exhibitors, and it is a matter for general congratulation that the correctness of this contention has at last been recognized. It is a notable victory for common sense and justice, and the WESTERN ELECTRICIAN is happy at having done its share to achieve this result.

OUR thanks are due, and are gratefully tendered, to the *Electrical World* of June 17th for its graceful compliment to the WESTERN ELECTRICIAN in the course of a bit of editorial correspondence from Chicago entitled "World's Fair at Short and Long Range." The subject under consideration was the publication of articles in the electrical press on the tower of light in electricity building, and, at the risk of being charged with vanity, we reprint the following paragraph:

> First of all, there is our western contemporary—always enterprising, always alert and bright; it plumes itself upon a genuine scoop, for such it succeeded in making, upon its more conservative contemporaries who believe in the old adage that "All things good come to him who waits."

It would not be becoming for us to comment on the characteristics attributed to this journal in the above quotation, but we may be permitted to remark, since the matter has been brought up, that the *World* is entirely correct in stating that the WESTERN ELECTRICIAN scored "a genuine scoop" over its contemporaries (including the *World*) by being the first to present a picture of the tower of light which forms such a prominent feature of the electricity building at the World's Fair.

After this generous admission on the part of our eastern contemporary, we are puzzled to account for its subsequent declaration that the WESTERN ELECTRICIAN "may justly pride itself upon being a good second to (and only two months behind) the *Electrical World*." These two statements are not consistent. How, if we made "a genuine scoop" on our contemporaries, could we have done so by publishing what one of them had covered two month before? In transporting an important portion of its staff to the rush and whirl of Chicago life, our New York contemporary has become somewhat confused, and appears to have lost, temporarily at least, the clearness of mental vision so necessary to the proper conduct of a technical journal.

The *World* evidently refers, by its "two months behind" allusion, to a sketch printed in its issue of April 8th and labeled "The Central Exhibit of the Electricity Building." But this was not a picture of the tower of light. Far from it. It was simply the artist's idea of what the structure would look like—pictorial guess work, in fact. No one will deny that the attempt was ingenious and audacious, and it is not difficult to detect a resemblance between the *World's* sketch and the tower as actually built. But it cannot be claimed for an instant that this delineation is a representation of the complete structure. A comparison of the picture with the WESTERN ELECTRICIAN'S illustration, made from the first photograph of the tower, will show the difference between imagination and solid fact. As well might the *World* have guessed at the result of the Goebel lamp case, and afterward, on seeing the WESTERN ELECTRICIAN'S extra with the decision in full, plumed itself on having the first report of the decision of the court. No; the WESTERN ELECTRICIAN printed the first picture of the tower of light—first in this as it is in all matters connected with the electrical features of the World's Fair.

The description accompanying the picture of April 8th shows that the whole thing was simply guess work. It speaks of the tower as 72 feet in height; of the "enormous glass shaft," and of "the powerful arc lamp, which surmounts the brilliant pile." Even the name attached to the structure was not known, and all the statements quoted are incorrect. The introduction of an arc lamp on a tower erected to glorify the incandescent light was particularly unfortunate. The whole production revealed simply an effort to strike the right thing by surmise—a feat not without parallel in the previous history of the *World*.

Evidently alluding to a controversy in which it has recently been engaged, and with which we have no concern, our contemporary expresses some solicitude at the manner in which the picture came in our possession. We are happy to be able to assure it that our conscience is easy on that score. Indeed, from the title of the article and the subsequent extended reference to the "carpenters' plans" of another contemporary, we more than suspect that the burden of the *World's* quizzical remarks is directed at that contemporary. However that may be, we desire to make clear one point—the sketch in the *World* of April 8th was not a picture of the tower of light, the first authentic illustration of that structure appearing in the WESTERN ELECTRICIAN of June 3d.

Light and other High Frequency Phenomena.

(*Continued from page* 325).

to join the condenser in series with the self-induction. It is clear that in such combinations there will be, for a given frequency, and considering only the fundamental vibration, values which will give the best result, with the condenser in shunt to the self-induction coil; of course more such values than with the condenser in series. But practical conditions determine the selection. In the latter case in performing the experiments one may take a small self-induction and a large capacity or a small capacity and a large self-induction, but the latter is preferable, because it is inconvenient to adjust a large capacity by small steps. By taking a coil with a very large self-induction the critical capacity is

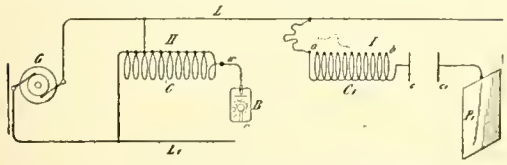


FIG. 20. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—PLAN FOLLOWED IN OBSERVING THE EFFECTS OF RESONANCE.

reduced to a very small value, and the capacity of the coil itself may be sufficent. It is easy, especially by observing certain artifices, to wind a coil through which the impedance will be reduced to the value of the ohmic resistance only and for any coil there is, of course, a frequency at which the maximum current will be made to pass through the coil. The observation of the relation between self-induction, capacity and frequency is becoming important in the operation of alternate current apparatus, such as transformers or motors, because by a judicious determination of the elements the employment of an expensive condenser becomes unnecessary. Thus it is possible to pass through the coils of an alternating current motor under the normal working conditions the required current with a low electromotive force and do away entirely with the false current, and the larger the motor the easier such a plan becomes practicable; but it is necessary for this to employ currents of very high potential or high frequency.

In Fig. 20 *i* is shown a plan which has been followed in the study of the resonance effects by means of a high frequency alternator. *C* is a coil of many turns, which is divided in small separate sections for the purposes of adjustment. The final adjustment was made sometimes with a few thin iron wires (though this is not always advisable) or with a closed secondary. The coil *C* is connected with one of its ends to the line *L* from the alternator *G*, and with the other end to one of the plates *c* of a condenser cc_1, the plate c_1 of the latter being connected to a much larger plate P_1. In this manner both capacity and self-induction were adjusted to suit the dynamo frequency.

As regards the rise of potential through resonant action, of course, theoretically, it may amount to anything since it depends on self-induction and resistance, and since these may have any value. But in practice one is limited in the selection of these values, and besides these there are other limiting causes. One may start with, say, 1,000 volts, and raise the electromotive force to fifty times that value, but one cannot start with 100,000 and raise it to ten times that value because of the losses in the media, which are great, especially if the frequency is high. It should be possible to start with, for instance, two volts from a high or low frequency circuit of a dynamo and raise the electromotive force to many hundred times that value. Thus coils of the proper dimensions might be connected each with only one of its ends to the mains from a machine of low electromotive force, and though the circuit of the machine would not be closed in the ordinary acceptance of

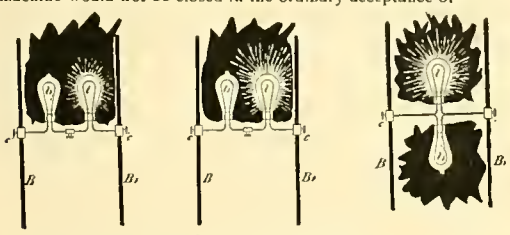


FIG. 22*a*, 22*b* AND 22*c*. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—SHOWING THE EFFECT OF THE PRESENCE OF A GASEOUS MEDIUM.

the term, yet the machine might be burned out if a proper resonance effect would be obtained. I have not been able to produce, nor have I observed with currents from the dynamo machine, such great rises of potential. It is possible, if not probable, that with currents obtained from apparatus containing iron the disturbing influence of the latter is the cause that these theoretical possibilities cannot be realized. But if such is the case I attribute it solely to the hysteresis and Faucault current losses in the core. Generally it was necessary to transform upward, when the electromotive force was very low, and usually an ordinary form of induction coil was employed, but sometimes the arrangement illustrated in Fig. 20 II has been found to be convenient. In this case a coil *C* is made in a great many sections, a few of these being used as the primary. In this manner both primary and secondary are adjustable. One end of the coil is connected to the line L_1 from the alternator, and the other line *L* is connected to the intermediate point of the coil. Such a coil with adjustable primary and secondary will be found also convenient in experiments with the disruptive discharge. When true resonance is obtained the top of the wave must of course be on the free end of the coil as, for instance, at the termi-

FIG. 23. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—CURIOUS INCANDESCENCE OF A WIRE.

nal of the phosphoresence bulb *B*. This is easily recognized by observing the potential of a point on the wire *w* nearer to the coil.

In connection with resonance effects and the problem of transmission of energy over a single conductor which was previously considered, I would say a few words on a subject which constantly fills my thoughts and which concerns the welfare of all. I mean the transmission of intelligible signals or perhaps even power to any distance without the

FIG. 21. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—ENERGY TRANSMISSION TO ANY DISTANCE WITHOUT WIRES.

use of wires. I am becoming daily more convinced of the practicability of the scheme; and though I know full well that the great majority of scientific men will not believe that such results can be practically and immediately realized, yet I think that all consider the developments in recent years by a number of workers to have been such as to encourage thought and experiment in this direction. My conviction has grown so strong that I no longer look upon this plan of energy or intelligence transmission as a mere theoretical possibility, but as a serious problem in electrical engineering, which must be carried out some day. The idea of transmitting intelligence without wires is the natural outcome of the most recent results of electrical investigations. Some enthusiasts have expressed their belief that telephony to any distance by induction through the air is possible. I cannot stretch my imagination so far, but I do firmly believe that it is practicable to disturb

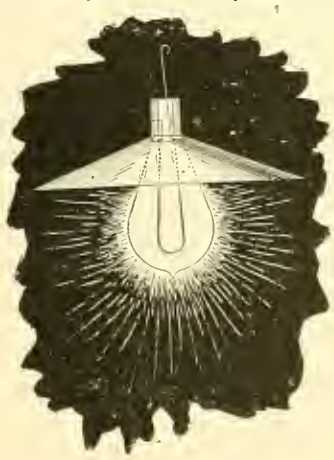


FIG. 24. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—UTILIZING THE HEATING EFFECT OF CONDUCTION CURRENT AND BOMBARDMENT.

by means of powerful machines the electrostatic condition of the earth and thus transmit intelligible signals and perhaps power. In fact, what is there against the carrying out of such a scheme? We now know that electric vibration may be transmitted through a single conductor. Why then not try to avail ourselves of the earth for this purpose? We need not be frightened by the idea of distance. To the weary wanderer counting the mile-posts the earth may appear very large, but to that happiest of all men, the astronomer, who gazes at the heavens and by their standard judges the magnitude of our globe, it appears very small. And so I think it must seem to the electrician, for when he considers the speed with which an electric disturbance is propagated through the earth all his ideas of distance must completely vanish.

A point of great importance would be first to know what is the capacity of the earth, and what charge does it contain if electrified? Though we have no positive evidence of a charged body existing in space without other oppositely electrified bodies being near, there is a fair probability that the earth is such a body, for by whatever

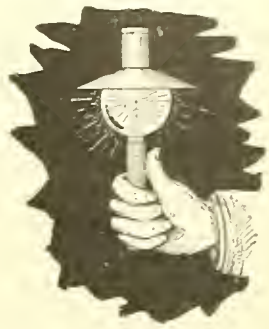


FIG. 26. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—INCANDESCENCE OF A SOLID.

process it was separated from other bodies—and this is the accepted view of its origin—it must have retained a charge, as occurs in all processes of mechanical separation. If it be a charged body insulated in space its capacity should be extremely small, less than one-thou-

FIG. 25. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—ILLUSTRATING LATERAL DIFFUSION.

sandth of a farad. But the upper strata of the air are conducting, and so, perhaps, is the medium in free space beyond the atmosphere, and these may contain an opposite charge. Then the capacity might be incomparably greater. In any case it is of the greatest importance to get an idea of what quantity of electricity the earth contains. It is difficult to say whether we shall ever acquire this necessary knowledge, but there is hope that we may

FIG. 27. LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.—PHOSPHORESCENCE.

and that is by means of electrical resonance. If ever we can ascertain at what period the earth's charge, when disturbed, oscillates with respect to an oppositely electrified system or known circuit, we shall know a fact possibly of the greatest importance to the welfare of the human race.

I propose to seek for the period by means of an electrical oscillator, or a source of alternating electric currents. One of the terminals of the source would be connected to earth as, for instance, to the city water mains, the other to an insulated body of large surface. It is possible that the outer conducting air strata or free space contains an opposite charge and that, together with th

earth, they form a condenser of very large capacity. In such case the period of vibration may be very low and an alternating dynamo machine might serve for the purpose of the experiment. I would then transform the current to a potential as high as it would be found possible and connect the ends of the high tension secondary to the ground and to the insulated body. By varying the frequency of the currents and carefully observing the potential of the insulated body and watching for the disturbance at various neighboring points of the earth's surface resonance might be detected. Should, as the majority of scientific men in all probability believe, the period be extremely small, then a dynamo machine would not do and a proper electrical oscillator would have to be produced and perhaps it might not be possible to obtain such rapid vibrations. But whether this be possible or not, and whether the earth contains a charge or not, and whatever may be its period of vibration, it certainly is possible—for of this we have daily evidence—to produce some electrical disturbance sufficiently powerful to be perceptible by suitable instruments at any point of the earth's surface.

Assume that a source of alternating currents S be connected, as in Fig 21, with one of its terminals to earth (conveniently to the water mains) and with the other to a body of large surface P. When the electric oscillation is set up there will be a movement of electricity in and out of P, and alternating currents will pass through the earth, converging to, or diverging from, the point C where the ground connection is made. In this manner neighboring points on the earth's surface within a certain radius will be disturbed. But the disturbance will diminish with the distance, and the distance at which the effect will still be perceptible will depend on the quantity of electricity set in motion. Since the body P is insulated, in order to displace a considerable quantity the potential of the source must be excessive, since there would be limitations as to the surface of P. The conditions might be adjusted so that the generator or source S will set up the same electrical movement as though its circuit were closed. Thus, it is certainly practicable to impress an electric vibration at least of a certain low period, upon the earth, by means of proper machinery. At what distance such a vibration, might be made perceptible can only be conjectured. I have on another occasion considered the question how the earth might behave to electric disturbances. There is no doubt that, since in such an experiment the electrical density at the surface could be but extremely small considering the size of the earth, the air would not act as a very disturbing factor and there would be not much energy lost through the action of the air which would be the case if the density were great. Theoretically, then, it could not require a great amount of energy to produce a disturbance perceptible at great distance, or even all over the surface of the globe. Now it is quite certain that at any point within a certain radius of the source S a properly adjusted self-induction and capacity device can be set in action by resonance. But not only can this be done, but another source S_1 Fig. 21, similar to S, or any number of such sources can be set to work in synchronism with the latter, and the vibration thus intensified and spread over a large area, or a flow of electricity produced to or from the source S_1 if the same be of opposite phase to the source S. I think that beyond doubt it is possible to operate electrical devices in a city through the ground or pipe system by resonance from an electrical oscillator located at a central point. But the practical solution of this problem would be of incomparably smaller benefit to man than the realization of the scheme of transmitting intelligence or perhaps power to any distance through the earth or environing medium. If this is at all possible, distance does not mean anything. Proper apparatus must first be produced by means of which the problem can be attacked, and I have devoted much thought to this subject. I am firmly convinced that it can be done and hope that we shall live to see it done.

Returning now to the light effects which it has been the chief object to investigate, it is thought proper to divide these effects into four classes: 1. Incandescence of a solid. 2. Phosphoresence. 3. Incandescence or phosphorescence of a rarefied gas, and 4. Luminosity produced in a gas at ordinary pressure. The first question is: How are these luminous effects produced? In order to answer this question as satisfactorily as I am able to do in the light of accepted views and with the experience acquired, and to add some interest to this demonstration, I shall dwell here upon a feature which I consider of great importance, inasmuch as it promises, besides, to throw a better light upon the nature of most of the phenomena produced by high frequency electric currents. I have on other occasions pointed out the great importance of the presence of the rarefied gas or atomic medium in general around the conductor through which alternate currents of high frequency are passed, as regards the heating of the conductor by the currents. My experiments, described some time ago, have shown that the higher the frequency and potential difference of the currents the more important becomes the rarefied gas in which the conductor is immersed as a factor of the heating. The potential difference, however, is, as I then pointed out, a more important element than the frequency. When both of these are sufficiently high the heating may be almost entirely due to the presence of the rarefied gas. The experiments to follow will show the importance of the rarefied gas, or generally of gas at ordinary or other pressure, as regards the incandescence or other luminous effects produced by currents of this kind.

I take two ordinary 50 volt 16 candle power lamps which are in every respect alike, with the exception that one has been opened at the top and the air has filled the bulb, while the other is at the ordinary degree of exhaustion of commercial lamps. When I attach the lamp which is exhausted to the terminal of the secondary of the coil, which I have already used, as in experiments illustrated in Fig. 19a for instance, and turn on the current, the filament as you have before seen comes to high incandescence. When I attach the second lamp, which is filled with air, instead of the former, the filament still glows, but much less brightly. This experiment illustrates only in part the truth of the statements before made. The importance of the filaments being immersed in rarefied gas is plainly noticeable but not to such a degree as might be desirable. The reason is that the secondary of this coil is wound for low tension, having only 150 turns, and the potential difference at the terminals of the lamp is therefore small. Were I to take another coil with many more turns in the secondary, the effect would be increased, since it depends partially on the potential difference, as before remarked. But since the effect likewise depends on the frequency, it may be properly stated that it depends on the time rate of the variation of the potential difference. The greater this variation the more important becomes the gas as an element of heating. I can produce a much greater rate of variation in another way, which, besides, has the advantage of doing away with the objections, which might be made in the experiment just shown, even if both the lamps were connected in series or multiple arc to the coil, namely, that in consequence of the reactions existing between the primary and secondary coil the conclusions are rendered uncertain. This result I secure by charging from an ordinary transformer, which is fed from the alternating current supply station, a battery of condensers, and discharging the latter directly through a circuit of small self-induction, as before illustrated in Figs. 19a, 19b, 19c.

In Figs. 22a, 22b and 22c, the heavy copper bars BB_1 are connected to the opposite coatings of a battery of condensers, or generally in such way that the high frequency or sudden discharges are made to traverse them. I connect first an ordinary 50 volt incandescent lamp to the bars by means of the clamps cc. The discharges being passed through the lamp, the filament is rendered incandescent, though the current through it is very small, and would not be nearly sufficient to produce a visible effect under the conditions of ordinary use of the lamp. Instead of this I now attach to the bars another lamp exactly like the first, but with the seal broken off, the bulb being therefore filled with air at ordinary pressure. When the discharges are directed through the filament, as before, it does not become incandescent. But the result might still be attributed to one of the many possible reactions. I therefore connect both the lamps in multiple arc as illustrated in Fig. 22a. Passing the discharges through both the lamps, again the filament in the exhausted lamp l glows very brightly, while that in the non-exhausted lamp l_1 remains dark as previously. But it should not be thought that the latter lamp is taking only a small fraction of the energy supplied to both the lamps; on the contrary, it may consume a considerable portion of the energy, and it may become even hotter than the one which burns brightly. In this experiment the potential difference at the terminals of the lamps varies in sign theoretically three to four million times a second. The ends of the filaments are correspondingly electrified, and the gas in the bulbs is violently agitated and a large portion of the supplied energy is thus converted into heat. In the non-exhausted bulb there being a few million times more gas molecules than in the exhausted one, the bombardment, which is most violent at the ends of the filament in the neck of the bulb, consumes a large portion of the energy without producing any visible effect. The reason is that there being many molecules, the bombardment is quantitatively considerable, but the individual impacts are not very violent. The speeds of the molecules are comparatively small, owing to the small free path. In the exhausted bulb, on the contrary, the speeds are very great, and the individual impacts are violent, and therefore better adapted to produce a visible effect. Besides, the convection of heat is greater in the former bulb. In both the bulbs the current traversing the filaments is very small, incomparably smaller than that which they require on an ordinary low frequency circuit. The potential difference, however, at the ends of the filaments is very great, and might be possibly 20,000 volts or more, if the filaments were straight and their ends far apart. In the ordinary lamp a spark generally occurs between the ends of the filament or between the platinum wires outside, before such a difference of potential can be reached.

It might be objected in the experiment before shown that the lamps, being in multiple arc, the exhausted lamp might take a much larger current and that the effect observed might not be exactly attributable to the action of the gas in the bulbs. Such objections will lose much weight if I connect the lamps in series, with the same result. When this is done and the discharges are directed through the filaments it is again noted that the filament in the non-exhausted bulb l_1 remains dark, while that in the exhausted one (l) glows even more intensely than under its normal conditions of working, Fig. 22b. According to general ideas the current through the filaments should now be the same, were it not modified by the presence of the gas around the filaments.

At this juncture I may point out another interesting feature, which illustrates the effect of the rate of change of potential of the currents. I will leave the two lamps connected in series to the bars BB_1 as in the previous experiment, Fig. 22b, but will presently reduce considerably the frequency of the currents, which was excessive in the experiment just before shown. This I may do by inserting a self-induction coil in the path of the discharges, or by augmenting the capacity of the condensers. When I now pass these low-frequency discharges through the lamps, the exhausted lamp l again is as bright as before, but it is noted also that the non-exhausted lamp l_1 glows, though not quite as intensely as the other. Reducing the current through the lamps, I may bring the filament in the latter lamp to redness, and, though the filament in the exhausted lamp l is bright, Fig. 22c, the degree of its incandescence is much smaller than in Fig. 22b, when the currents were of a much higher frequency.

In these experiments the gas acts in two opposite ways in determining the degree of the incandescence of the filaments, that is, by convection and bombardment. The higher the frequency and potential of the currents, the more important becomes the bombardment. The convection on the contrary should be the smaller, the higher the frequency. When the currents are steady, there is practically no bombardment and convection may therefore with such currents also considerably modify the degree of incandescence and produce results similar to those just before shown. Thus, if two lamps exactly alike, one exhausted and one not exhausted, are connected in multiple arc or series to a direct current machine, the filament in the non-exhausted lamp will require a considerably greater current to be rendered incandescent. This result is entirely due to convection and the effect is the more prominent the thinner the filament. Professor Ayrton and Mr. Kilgour some time ago published quantitative results concerning the thermal emissivity by radiation and convection in which the effect of thin wires was clearly shown. This effect may be strikingly illustrated by preparing a number of small short glass tubes, each containing through its axis the thinnest obtainable platinum wire. If these tubes be highly exhausted, a number of them may be connected in multiple arc to a direct-current machine and all of the wires may be kept at incandescence with a smaller current than that required to render incandescent a single one of the wires if the tube be not exhausted. Could the tubes be so highly exhausted that convection would be nil, then the relative amounts of heat given off by convection and radiation could be determined without the difficulties attending thermal quantitative measurements. If a source of electric impulses of high frequency and very high potential is employed, a still greater number of the tubes may be taken and the wires rendered incandescent by a current not capable of warming perceptibly a wire of the same size immersed in air at ordinary pressure, and conveying the energy to all of them.

I may here describe a result which is still more interesting, and to which I have been led by the observation of these phenomena. I noted that small differences in the density of the air produced a considerable difference in the degree of incandescence of the wires, and I thought that, since in a tube, through which a luminous discharge is passed, the gas is generally not of uniform density, a very thin wire contained in the tube might be rendered incandescent at certain places of smaller density of the gas, while it would remain dark at the places of greater density where the convection would be greater and the bombardment less intense. Accordingly a tube t was prepared, as illustrated in Fig. 23, which contained through the middle a very fine platinum wire w. The tube was exhausted to a moderate degree and it was found that when it was attached to the terminal of a high frequency coil the platinum wire w would, indeed, become incandescent in patches, as illustrated in Fig. 23. Later a number of these tubes with one or more wires were prepared, each showing this result. The effect was best noted when the striated discharge occurred in the tube, but was also produced when the striæ were not visible, showing that, even then, the gas in the tube was not of uniform density. The position of the striæ was generally such that the rarefactions corresponded to the places of incandescence or greater brightness on the wire w. But in a few instances it was noted that the bright spots on the wire were covered by the dense parts of the striated discharge as indicated by l in Fig. 23, though the effect was barely perceptible. This was explained in a plausible way by assuming, that the convection was not widely different in the dense and rarefied places, and that the bombardment was greater on the dense places of the striated discharge. It is, in fact, often observed in bulbs, that under certain conditions a thin wire is brought to higher incandescence when the air is not too highly rarefied. This is the case when the potential of the coil is not high enough for the vacuum, but the result may be attributed to many different causes. In all cases this curious phenomenon of incandescence disappears when the tube, or rather the wire, acquires throughout a uniform temperature.

Disregarding now the modifying effect of convection there are then two distinct causes which determine the incandescence of a wire or filament with varying currents, that is, conduction current and bombardment. With steady currents we have to deal only with the former of these two causes, and the heating effect is a minimum, since the resistance is least to steady flow. When the current is a varying one, the resistance is greater and hence the heating effect is increased. Thus if the rate of change of the current is very great, the resistance may increase to such an extent that the filament is brought to incandescence with inappreciable currents, and we are able to take a short and thick block of carbon or other material and bring it to bright incandescence with a current incomparably smaller than that required to bring to the same degree of incandescence an ordinary thin lamp filament with a steady or low frequency current. This result is important, and illustrates how rapidly our views on these subjects are changing, and how quickly our field of knowledge is extending. In the art of incandescent lighting, to view this result in one aspect only, it has been commonly considered as an essential requirement for practical success, that the lamp filament should be thin and of high resistance. But now we know that the resistance to the steady flow of the filament does not mean anything; the filament might as well be short and thick; for if it be immersed in rarefied gas it will become incandescent by the passage of a small current. It all depends on the frequency and potential of the currents. We may conclude from this, that it would be of advantage, so far as the lamp is considered, to employ high frequencies for lighting, as they allow the use of short and thick filaments and smaller currents.

If a wire or filament be immersed in a homogeneous medium, all the heating is due to true conduction current, but if it be enclosed in an exhausted vessel the conditions are entirely different. Here the gas begins to act, and the heating effect of the conduction current, as is shown in

many experiments, may be very small compared with that of the bombardment. This is especially the case if the circuit is not closed, and the potentials, of course, very high. Suppose a fine filament enclosed in an exhausted vessel be connected with one of its ends to the terminal of a high tension coil and with its other end to a large insulated plate. Though the circuit is not closed, the filament, as I have before shown, is brought to incandescence. If the frequency and potential be comparatively low, the filament is heated by the current passing through it. If the frequency and potential, and principally the latter, be increased, the insulated plate need be but very small, or may be done away with entirely, still the filament will become incandescent, practically all the heating being then due to the bombardment. A practical way of combining both the effects of conduction current and bombardment is illustrated in Fig. 24, in which an ordinary lamp is shown, provided with a very thin filament, which has one of the ends of the latter connected to a shade serving the purpose of the insulated plate, and the other end to the terminal of a high tension source. It should not be thought that only rarefied gas is an important factor in the

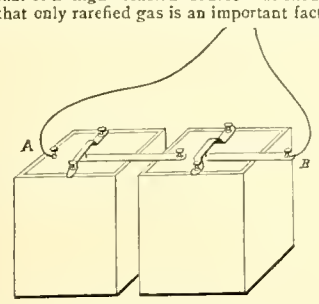


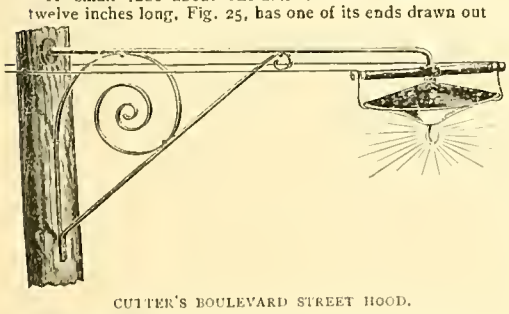
FIG. 2. A NEW BATTERY.

heating of a conductor by varying currents, but gas at ordinary pressure may become important if the potential difference and frequency of the currents is excessive. On this subject I have already stated that when a conductor is fused by a stroke of lightning the current through it may be exceedingly small, not even sufficient to heat the conductor perceptibly were the latter immersed in a homogeneous medium.

From the preceding it is clear that when a conductor of high resistance is connected to the terminals of a source of high frequency currents of high potential, there may occur considerable dissipation of energy, principally on the ends of the conductor, in consequence of the action of the gas surrounding the conductor. Owing to this, the current through a section of the conductor at a point midway between its ends may be much smaller than through a section near the ends. Furthermore, the current passes principally through the outer portions of the conductor, but this effect is to be distinguished from the skin effect as ordinarily interpreted, for the latter would or should occur also in a continuous incompressible medium. If a great many incandescent lamps are connected in series to a source of such currents, the lamps at the ends may burn brightly, whereas those in the middle may remain entirely dark. This is due principally to bombardment, as before stated. But even if the currents be steady, provided the difference of potential be very great, the lamps at the ends will burn more brightly than those in the middle. In such case there is no rhythmical bombardment and the result is produced entirely by leakage. This leakage or dissipation into space when the tension is high is considerable when incandescent lamps are used, and still more considerable with arcs, for the latter act like flames. Generally, of course, the dissipation is much smaller with steady than with varying currents.

I have contrived an experiment which illustrates in an interesting manner the effect of lateral diffusion. If a very long tube is attached to the terminal of a high frequency coil, the luminosity is greatest near the terminal and falls off gradually toward the remote end. This is more marked if the tube is narrow.

A small tube about one-half inch in diameter and twelve inches long, Fig. 25, has one of its ends drawn out



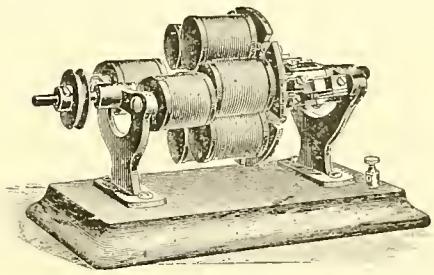
CUTTER'S BOULEVARD STREET HOOD.

into a fine fiber f nearly three feet long. The tube is placed in a brass socket T, which can be screwed on the terminal T_1 of the induction coil. The discharge passing through the tube first illuminates the bottom of the same, which is of comparatively large section; but through the long glass fiber the discharge cannot pass. But gradually the rarefied gas inside becomes warmed and more conducting and the discharge spreads into the glass fibre. This spreading is so slow that it may take half a minute or more until the discharge has worked through up to the top of the glass fiber, then presenting the appearance of a strongly luminous thin thread. By adjusting the potential at the terminal the light may be made to travel upward at any speed. Once, however, the glass fiber is heated the discharge breaks through its entire length instantly. The interesting point to be noted is that, the higher the frequency of the currents, or in other words, the greater relatively the lateral dissipation, at a slower rate may the light be made to propagate through the fiber. This experiment is best performed with a highly exhausted and freshly made tube. When the tube has been used for some time the experiment often fails. It is possible that the gradual and slow impairment of the vacuum is the cause. This slow propagation of the discharge through a very narrow glass tube corresponds exactly to the propagation of heat through a bar warmed at one end. The quicker the heat is carried away laterally the longer time it will take for the heat to warm the remote end. When the current of a low frequency coil is passed through the fiber from end to end, then the lateral dissipation is small and the discharge instantly breaks through almost without exception.

After these experiments and observations, which have shown the importance of the discontinuity or atomic structure of the medium and which will serve to explain, in a measure at least, the nature of the four kinds of light effects produceable with these currents, I may now give you an illustration of these effects. For the sake of interest I may do this in a manner which to many of you might be novel. You have seen before that we may now convey the electric vibration to a body by means of a single wire or conductor of any kind. Since the human frame is conducting I may convey the vibration through my body.

First, as in some previous experiments, I connect my body with one of the terminals of a high tension transformer and take in my hands an exhausted bulb which contains a small carbon button mounted upon a platinum wire leading to the outside of the bulb, and the button is rendered incandescent as soon as the transformer is set to work, Fig. 26. I may place a conducting shade on the bulb, which serves to intensify the action, but is not necessary. Nor is it required that the button should be in conducting connection with the hand through a wire leading through the glass, for sufficient energy may be transmitted through the glass itself by inductive action to render the button incandescent.

Next I take a highly exhausted bulb containing a strongly phosphorescent body, above which is mounted a small plate of aluminum on a platinum wire leading to the



MASON MOTOR.

outside, and the currents flowing through my body excite intense phosphorescence in the bulb, Fig. 27.

Mason Motor.

The motor in the accompanying illustration is the invention of J. H. Mason, of the Mason Electric company, of New York, and is known as the Mason motor No. 2. It is fitted with nickel plated cover, and is especially adapted for running sewing machines and other small machinery. All parts are interchangeable. Through a very unique plan, in the construction of these motors a past and serious drawback in the way of the working loose of the terminals, or binding posts, which is occasioned by the constant vibration of the armature, thereby making poor contact in the connecting wires, has been overcome. It is especially designed to work at a fast rate of speed for running the small ventilating electric fans.

A New Battery.

The Atlantic is the name of a new primary battery which has found its way on the market and which is quite worthy of mention. Fig. 1 shows the interior of the battery. It consists of an india rubber cell 6½ inches by 7 inches by 8 inches high, 18 carbon pencils, a porous cup and a zinc element. Without lifting the cover, which is of the tight fitting kind, or disconnecting the wires when the battery is not in operation, the zinc can be raised out of the solution by a handle on the cover. Any two fluid carbon battery solutions can be used. When fully charged, the battery shows on short circuit, it is claimed, 40 amperes and 2 volts, and has a capacity of 150 amperc hours. It is so constructed that the connections will not corrode, and there is no change in internal resistance. It will maintain constant electromotive force during the life of the charge, and there is no consumption of zinc while the battery is not in operation.

Fig. 2 shows the battery when used in series of two or more cells. This battery is very compact and well constructed, and is especially adapted for medical purposes to run fan motors, phonographs, etc., and is being introduced by the Electro-chemical & Specialty company, 136 Liberty street, New York.

Cutter's Boulevard Street Hood.

The accompanying illustration shows an ornamental form of street hood for electric lamps, for use where the regular gooseneck is too plain. It is brought out by George Cutter, Chicago. The hood proper has the same carefully worked out details as Mr. Cutter's standard forms, including the special nozzles and hinge. The supporting bracket was made with particular attention to strength for bearing the weight of the lamp at a distance of from three to six feet from the pole or wall. The conducting wires are well insulated from the bracket arm and always in plain sight, so as to avoid all chances of grounds. The Cutter boulevard street hood seems to be meeting with

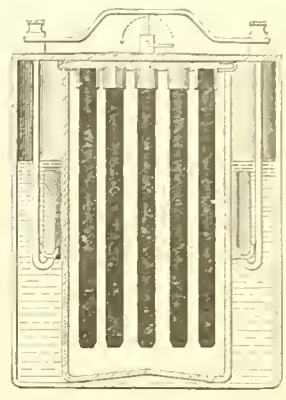
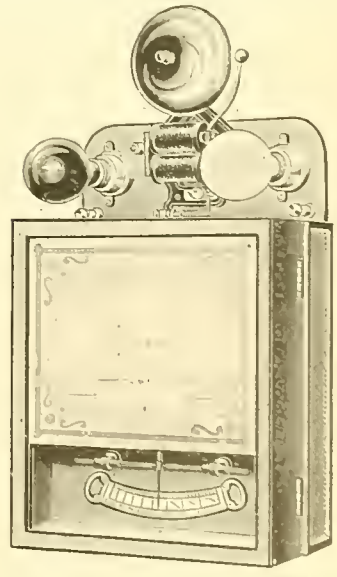


FIG. 1. A NEW BATTERY.

good success, for Mr. Cutter has already supplied large numbers to western towns.

The Tice-Lintner Potential Indicator.

The improved form of the Tice-Lintner potential indicator, as recently placed upon the market, is shown in the accompany illustration, and while not differing materially from the original instrument contains several improvements that go to make it a most perfect indicator. The advantages accruing from close potential regulation are so obvious that it is unnecessary to dwell at length upon them. Repeated tests with high efficiency lamps have been made with this instrument, resulting in every instance in increasing the life claimed for them. The Tice-Lintner potential indicator combines with a voltmeter of the highest degree of accuracy, permanency and dead-beat qualities, an alarm attachment of equal reliability, which immediately attracts the attention of the attendant to any change or variation in pressure, and the same is remedied before any damages ensues to the lamps or motors on the working circuits. Aside from the alarm the especial features of the instrument are the entire lack of permanent magnets, or any other deteriorating element, and the fact that it can be operated in the close vicinity of intense magnetic fields without disturbing the accuracy of



TICE-LINTNER POTENTIAL INDICATOR.

its reading. A neat circular is now being issued containing a full and complete description of the instrument, and all interested in prolonging the life and efficiency of their lamps should send for one to the Tice Lintner Electric company, Minneapolis, Minn.

The question of electric street lighting in Zumbrota, Minn., is being agitated.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 17.—It is the unexpected that happens. There is a strong impression rife that when the four members of the Rapid Transit Commission resigned, they were sanguine that the remaining commissioner, Mr. Starin, would take a similar step, and that his resignation would be promptly accepted, while they would be induced to reconsider their resignations and agree to act with a new commissioner who would be in harmony with their views. However, Mr. Starin disobligingly stuck to his post, and thus circumvented such a procedure, if it were intended. Mayor Gilroy says it has cost the city $120,000 to teach the present commissioners something about rapid transit, and he does not propose that that amount shall be entirely wasted. He holds that this expense cannot be made a charge upon the purchasers of franchises, nor is there any means of having it refunded. He therefore declines to accept the proffered resignations of the four commissioners until he becomes "fully convinced that it is hopeless to expect from the commission as at present constituted the relief that the city so urgently needs in the matter of rapid transit." An interesting feature of the week's developments in rapid transit matters has been the fluctuations in Manhattan stock. After the resignation of its friends on the commission, Manhattan stock immediately jumped up to 132. Two days after, however, when Mr. Starin stolidly showed himself proof against every effort to induce him to resign, confidence in Manhattan's eventual victory declined, and there was a drop of two points in the stock. It was expected that a meeting would be held by the commission immediately after Mayor Gilroy's ultimatum, but nothing has yet been done. None of the commissioners seems madly anxious to take upon himself the unwonted responsibility of arriving at a definite line of policy in this humid weather. Mr. Inman stated yesterday that after waiting three days for a meeting, his patience was exhausted and he was off to Chicago to see the fair and would not be back until some time in July. By the time he gets back Mr. Steinway will probably have gone to the country, as he is run down in health. Mr. Spencer has not yet returned from Saratoga, where he is recruiting, and Mr. Bushe said yesterday that he is soon going on a vacation. It is therefore not likely that there will be any progress toward rapid transit this summer. Mayor Gilroy is impatient at this further shelving of an issue of such importance, and has bidden the commissioners to meet on Monday next. You can call spirits from the vasty deep, but they may not come, and the extent of the response of the commissioners to the mayor's behest is an uncertain quantity. The conviction is growing that the only way for New York to get rapid transit is to treat with the Manhattan company. Mr. Steinway says: "There is no other way in which we can solve the problem even temporarily. An underground system will undoubtedly be the final system, but since the Broadway railroad exposures, the Panama Canal and other scandals, capital is very timid when asked to take part in a public enterprise where it will be tied up for several years. I do not believe we could today sell a franchise for an independent system of elevated roads for this city." So the Manhattan is the favorite today, but the next question is that even if the city comes to terms with it, how long is such relief as that step might bring to last. Possibly before the summer is ended something may be decided in accordance with which a date may be fixed for the beginning of preparations to furnish the city with some additional transit facilities. In the course of three or four years we may have these additional facilities in operation, but long before they arrive we shall have as much outgrown the capabilities of the improved system which they will supply as we have at present outgrown the existing systems.

Jesse H. Bonnell is probably as well known among electricians as Bourke Cockran is among lawyers and politicians, and a lively passage at arms is now imminent between the two notables. Mr. Bunnell seeks relief from the turmoil and heat of the city during the summer months at his place at Sands Point, Long Island, a resort now much affected by New Yorkers. It appears that Mr. Cockran has fenced up a highway leading to the house of Mr. Bonnell, who is not disposed to put up with this restriction of his comforts and privileges. The hearing on the matter has been adjourned pending the preparation of a survey of the road. This contest promises to result in a large amount of litigation in the town of North Hampstead. A "ready other" are following up Mr. Cockran's example, and are closing up highways that have been public thoroughfares for a century. The interest in the situation is increased by the fact that Mr. Cockran has been served with the same dish that he has provided for Mr. Bunnell. The administrators of the Travis estate have erected the sign "No Thoroughfare" in a part of the main highway between Great Neck and Port Washington. This was once a private road, but for 100 years it has been open to the public, being known as the 'short cut through Manhasset Valley." The closing of it will increase the distance which Mr. Cockran and others now have to travel from the railway station at Great Neck when driving to their homes on Sands Point from nine to fourteen miles. So, altogether, there is a brisk little melee on the way, and Mr. Bunnell's many friends hope that he will come out of his side of it triumphant.

The struggle for street railway franchises in Brooklyn continues, and those who happen to have a political "pull" in the city of churches just now are likely to find it a very convenient and profitable possession. The Union Street Railway company last week offered $15,000 per mile for certain streets and $10,000 a mile for others. The Railroad Committee of the Brooklyn Board of Aldermen hesitated to accept what was probably about half the value of these franchises, and the secretary of the company has now offered $20,000 per mile for the first lot and $12,000 a mile for the others. But there is a diversity of opinion in Brooklyn as to the necessity of multiplying franchises and filling up an indefinite number of steets with car lines in order that the financial prosperity of those in power and their friends may be promoted, and last night the Common council chamber in the city hall was stormed by more than 1,000 property owners who came to enter their protest against certain of the proposed franchises. The speeches of the protestants were all short and to the point. The general argument was that Brooklyn had already all the surface and elevated roads that it required, and that whatever further traveling facilities were needed could be supplied by the addition of more cars on the present routes. The ringing of the trolley gongs appears also to be a sore point in Brooklyn, and was referred to as an intolerable nuisance. One of the speakers brought down the house with a reference to the high standard of "official purity of heart" required in the members of the Brooklyn Board of Aldermen. Another speaker contended that, if the extension of trolley lines was continued, it would be impossible to drive anything in Brooklyn except cows, and that the increase in insanity would necessitate the establishment of another St. Johnland. Among those present was a large contingent of ladies, one of whom denounced with special vigor the attempt to destroy the pastoral calm of the "purely home-like streets" of the city of Brooklyn. The meeting, at all events, brought out one fact, on which New Yorkers can ponder with profit: It showed that, when the people of Brooklyn consider that municipal license is in danger of overstepping the bounds of toleration, they are not too apathetic and selfish to come together and raise their voice, in the protection of their rights as citizens.

As the time for declaring the dividend on General Electric draws near there is heard a revival of the criticism regarding the policy of the company in making such a large division of profits among shareholders. It is, however, a noticeable as well as a significant fact that the unfavorable comment does not come from the stockholders themselves, and that the price of the shares in the market has been holding up well for the last few weeks. It is well known that this stock has been persistently raided since last February by Cammack and other bear traders, and it has come out of the ordeal in better shape than at one time appeared to be likely. D. O. Mills, one of the directors of the General Electric, states that the company will undoubtedly pay its quarterly dividend of 2 per cent. on the 1st of August, and that a declaration to that effect will be made in the early part of July. Another officer of the company is reported to have said that the earnings at present are at the rate of 20 per cent. on the stock.

A jury in the Brooklyn City Court yesterday brought in a verdict for $5,000 in favor of Mrs. Samuel H. Morrison, against the Metropolitan Telephone & Telegraph company of this city. Mr. Morrison lost his life in the building of the company in Cortlandt street. He was delivering letters, when he stepped through an elevator and fell to the bottom of the shaft. W. F. O.

Northwestern Notations.

MINNEAPOLIS, June 17.—The triumph of electricity over steam in the matter of interurban passenger traffic at Minneapolis and St. Paul is now just about complete. The electric line had been operated but a short time when the companies operating the steam car "short line" trains saw the handwriting on the wall and began taking off trains. The Great Northern company practically withdrew some time ago. Now the Milwaukee and St. Paul company announces the discontinuance of all its "short line" service. This leaves nothing but the "through" trains. This will result in crowding the interurban electrics more than ever, and will furnish an additional incentive for the early completion of the proposed second interurban line via St. Anthony Park.

Out of a graduating class of 250 at the University of Minnesota the following named took degrees as bachelors of electrical engineering: Arthur William Chase, Hastings; William Harry Dewey, Minneapolis; John De Mott Guthrie, Minneapolis; George Hart Morse, La Crosse, Wis.; Frank Ervin Reidhead, Minneapolis; Frank Wesley Springer, Anoka.

The Phoenix Electric company of Duluth has made a voluntary assignment to W. H. Squire. The immediate cause was the bringing by the W. S. Edwards Manufacturing company of Chicago of a suit for $463 in the Municipal Court. The official statement of the affairs of the company shows assets of $6,721, of which half is in the shape of outstanding accounts. The liabilities foot up $11,438.

The Electrical Engineering & Supply company has decided to remove its extensive establishment from St. Paul to Minneapolis. It has leased a large building on Second avenue south, near Washington avenue, and will soon be quartered there. In addition to its large general business the company proposes to handle incandescent lamps. The Packard lamp will be turned out in large quantities. The territory assigned to this company covers the whole Northwest out to the Pacific coast.

Frank Arnot who has been employed as electrician by the Minneapolis Street Railway company for some time received fatal shock the other night. He was discharging his regular duty making a shift at the switchboard, regulating the currents. The theory is that in some manner he placed both hands on the switchboard, making a short circuit through his body. Death was not instantaneous. He was thrown to the floor, partially recovered himself and staggered some distance. Then he fell dead. City Electric Inspector Deming after a thorough examination pronounced death purely accidental. Arnot was twenty-eight years old, married, and the remains were taken to Le Sueur, Minn.

The Western Union Telegraph company received a serious blow in the big fires at Fargo, N. D. Its building and equipment were totally wrecked. Its recovery and resumption of business were notable under the circumstances.

J. A. Folsom and George F. Blossom, of Minneapolis, have an invention for a trolley wire conduit which has been pronounced by experts a success. The conduit is to be between the rails. The wire is hermetically sealed and contact is made by the double trolley wheel pressing down a spring section above. The exposed part is insulated as soon as the trolley wheel has passed. A great saving of electricity is claimed.

The Minneapolis council's underground wire committee proposes to have heroic measures taken to force the companies to take their wires down. The city inspector reports that the claim that 75 per cent. of the wires are already down in the conduit district is altogether too high an estimate.

A handsome electric launch has been bought by O. C. and A. W. Hartman, of Duluth, Minn., from the Columbian Launch company of New York. The boat is the Electra. She is 32 feet long, finished in mahogany and will carry 30 people. She will run 60 to 80 miles at a charge at a speed of about 10 miles per hour.

Articles of incorporation of the Boulder Electric Power company have been filed at Livingston, Mont. The principal places of business will be the village of Creighton, Knox county, Nebraska, and Boulder Mining District, Park county, Montana. The object of the organization is the development of water power, maintaining flumes and ditches, the erection of electric power plants and the leasing of electric powers to mining companies. The capital stock is $500,000. The incorporators are A. N. Hawley, L. P. Ash, Charles W. Hamilton and E. A. Crum. The annual statement of the company shows the capital stock actually paid in, to be $10,150; the amount of assets, $20,000, consisting of dynamos, water wheel, power house, etc. The liabilities amount to $4,000.

Messrs. Stevens and Robinson, two St. Paul capitalists, were in Litchfield, Minn., recently, with a proposition to buy the city waterworks and electric light plant there. Their offer was to give $20,000 for the plant, but to pay nothing down, and charge the city about $1,000 a year for hydrants, street lights and sprinkling. Most of the councilmen thought the offer unsatisfactory. A committee of five was appointed to consider the matter.

A peculiar fire occurred at the Minneapolis exposition building the other day, which Fire Inspector Deming has

been studying. He reports that fire originated at four points, two of them just above the main entrance on the west side of the building, one under the flooring, where a stream of water made a connection between the earth and the woodenwork of the floor, and the last in the auditorium, where the principal damage was done. He has not fully solved the cause, but thinks that heavily charged wires crossed those running into the building and carried the current into the woodwork, fire ensuing wherever there was contact. The damage was nominal. The wires running into the building will be rearranged, so that there can be no possible chance of an accident of a similar nature.

It is said that the company that owns the electric light plant at Owatonna, Minn., is looking for a purchaser, and that the plant can be secured at a low figure. There is some talk of the city purchasing it.

The Western Union Telegraph company has declined to accept the ordinance requiring all electric companies in St. Paul to put their wires under ground within a certain territory. Three reasons were given for the refusal: First, that the ordinance discriminated in favor of the Edison Electric Light & Power company and the Northwestern Telephone Exchange company in exempting them from its provisions; second, "that we should be obliged to put down a certain mileage each year until January 1, 1897;" third, "that we should be subject to the provisions of any ordinance that the council may hereafter pass."

At a recent convention of the Minnesota Firemen's association there was much discussion of the matter of municipal control of electric wires. An agitation was started, which, it is thought, will result in some concerted action in this regard. N. L. P.

PERSONAL.

Russell Robb of the Shawmut Fuse Wire company, Boston, is in Chicago.

S. L. Firth, of the Novelty Electric company, Philadelphia, was in Chicago last week seeing the fair.

F. A. Hine, president of the Hine Eliminator company, New York, died at his residence at Tenafly, N. J., May 26th.

Anthony Reckenzaun of London is in Chicago, visiting the World's Fair, and looking after his interests in this country.

M. E. Baird of the Eddy Electric Manufacturing company, Windsor, Conn., was in Chicago last week. Mr. Baird was enthusiastic in his praise of the great exposition, and especially the electrical features.

NEW INCORPORATIONS.

Commercial Telegraph & Messenger company, New York, N. Y.; capital stock, $5,000; to construct and maintain lines of electric telegraph.

Riverside Electric company, Riverside, Cal.; capital stock, $100,000, generating electricity for all purposes, operating street railroads, etc.; Jarvis & Bush, Riverside, Cal.

Easton & Bangor Electric Railway company, Easton, Pa.; capital stock, $100,000; constructing and operating an electrical railway in Easton, Pa.; D. W. Nevin, Easton, Pa.

Portsmouth Street Railroad & Light company, Portsmouth, O.; capital stock, $125,000; operating a street railroad and furnishing light and power; Floyd L. Smith, Portsmouth, O.

Sloss-Stein Electric company, Chicago, Ill.; capital stock, $50,000; to manufacture and sell electric appliances, metal products and specialties; Sydney Stein, 85 Dearborn street, Chicago, Ill.

Independent Electric company, Chicago, Ill.; capital stock, $25,000; to do a general electrical manufacturing and machine shop business; H. E. Goodman, 39th street and Stewart avenue, Chicago, Ill.

Wagner Electro-medical company, Chicago, Ill.; capital stock, $50,000; to manufacture and sell physicians' electrical supplies and general electrical goods; Black & Goodwin, 1141 Rookery, Chicago, Ill.

Tri-City Power & Light company, Rock Island, Ill.; capital stock, $300,000; to manufacture appliances for and to furnish light, heat and power to inhabitants of Moline and Rock Island and vicinity, with gas, steam or electricity; R. H. MacMullan, Rock Island, Ill.

Citizens' Electric Light company of Wayne, Wayne, Pa.; capital stock, $5,000; supplying light, heat and power by means of electricity in Wayne, Pa.; J. S. Freman, 400 Chestnut street, Philadelphia, Pa.

Rogue River Water, Light & Power company, Grant's Pass, Ore.; capital stock, $50,000; to construct, equip, maintain and operate water works and an electric light system in the city of Grant's Pass, Ore.; George A. Pease, Portland, Ore.

International Storage Battery company, Detroit, Mich.; capital stock, $100,000; to manufacture and sell Woodward's tubular secondary electric storage battery and other electrical appliances; George W. Martin, 32 Ledyard street, Detroit, Mich.

C. & C. Electric company, Newark, N. J.; capital stock, $1,400,000; to manufacture and deal in electric motors and dynamos and electrical appliances; generating and transmitting light and power by electricity; Gould & Wilkie, 2 Wall street, New York, N. Y.

ELECTRIC LIGHTING.

The plant of the Galena, Ill., Electric Light company, it is rumored, will be removed to Baraboo, Wis.

Capitalists have made a proposition to the authorities of Fruitville, Cal., to erect an electric light plant.

Valley City, N. D., is soon to be electrically lighted. A twelve years' franchise has been granted.

At a special election, Onawa, Ia., authorized the expenditure of $8,000 to put in an electric light plant.

It is stated that a company will commence the work of putting in an electric light plant at Paola, Kan., shortly.

An electric light franchise has been granted to a company composed of Texas capitalists by the city council of El Reno, Ok.

The question of putting in an electric light plant at Ionia, Mich., to be owned and operated by the municipality, is being agitated.

After holding several town elections on the subject, Batavia, N. Y., has recently decided to construct and own its electric lighting plant.

At a recent election the people of Higginsville, Mo., voted to issue $17,000 in bonds for the establishment of an electric light and water works plant.

The people of Mellette, S. D., have under consideration a proposition to introduce electric lighting, the power to be derived from an artesian well.

Detroit, Mich., has decided to erect a municipal electric lighting plant, and bonds to the value of $600,000 have been authorized to pay for the same.

The Ida Grove, Ia., Electric company, with a capital stock of $15,000, has been organized, and contemplates supplying the town with electric light.

A concession has been granted for the establishment of a central electric light station and also an electric tramway at Pointe-aux-Trembles, near Montreal, Quebec.

The Waupun, Wis., Electric Light company has been granted a franchise to operate an electric light plant in that city. The city agrees to take 80 incandescent lights for street lighting.

An electric light company has been organized to put in a plant for electric lighting at Valley Falls, N. Y. It is also the intention of the company to furnish power and light for surrounding villages.

Garfield, Wash., voted on the question of bonding the city for electric light and waterworks recently. It was decided to issue bonds to the amount of $13,000 for waterworks and $7,000 for electric light.

The United States Electric Lighting company, Washington, D. C., has been granted permission to extend its underground conduits in many of the streets and avenues of the city. The work will be commenced at once.

The gas company which owns the concession for the establishment and operation of a central electric light station in Buda-Pesth, Austria, has given the contract for the electrical portion of the work to Schuckert & Co., Nuremberg, Germany.

A resolution has been introduced in the Houston, Tex., Council declaring it advisable for the city to maintain its own system of electric lighting and waterworks, and providing that a proposition be submitted to a vote of the people to authorize the creation of a bonded debt of $350,000 for that purpose.

The board of trustees of the Cleveland Asylum for the Insane, at Newburg, O., will receive proposals for the necessary wiring, dynamos, engines, etc., for the installation of an electric lighting plant for the asylum. The plant is to have a capacity of not less than 1,000 incandescent lights of 16 candle power, or their equivalent.

In the city of Gaudalajara, Mexico, is to be inaugurated this month a new system of electric lighting, which, it is said, will make it the best lighted city in Mexico. The power is generated at the great cataract of Juanacatlan, on the Santiago River, about fifteen miles from the city. The charge for incandescent lamps, of 16 candle power will be from 75 cents to $1 a month, in Mexican money—an unprecedentedly low rate for Mexico.

ELECTRIC RAILWAYS.

Lebanon and Myerstown, Pa., are to be connected by an electric railway.

It is proposed to establish an electric railway between Wellington and Nanaimo, B. C.

It is proposed to extend the electric railway at Ottawa, Can., to Hull, a neighboring town.

The extension of the electric railway from Concord, N. H., to Contoocook Park will soon be completed.

The Kingston, Ont., Street Railway company is applying for permission to change its power to electricity.

The Charleston, W. Va., Street Railway company has obtained a franchise for an electric street railway line.

An electric railway six miles in length connecting Portland, Me., and West Buxton in Saco Valley is projected.

Waterbury, Conn., proposes to replace horses with electric power on its street railways, and to largely extend the lines.

The Kanawha Electric Car company has asked the city council of Elk City, W. Va., for permission to build an electric line.

The Electric Railway Company has obtained control of the River View railway near Richmond, Va., and will equip it with electricity.

A bill is pending in the Pennsylvania Legislature limiting the carrying of freight on electric railways to 200 pounds for each package.

The electric railway between Yonkers and Mt. Vernon, N. Y., has been completed. Cars will run between the two cities every thirty minutes.

A project is on foot to construct and operate a trolley line between Rhinecliff and the town of Rhinebeck, New York, two and one-half miles distant.

Negotiations are progressing between the Vienna, Austria, Tramway company and Siemens & Halske, Berlin, with the view of adopting electric traction in Vienna.

A new electric street railway company has applied to the Brooklyn Council for a franchise over a number of streets in the city, offering $15,000 a mile for the same.

The East Woods Heights, N. Y., Electric Railway company's power house burned a short time ago. The Corliss engine, generators and cars were destroyed. The loss is $20,000; insurance, $10,000.

A survey has been made for an electric railroad from Potsdam to Colton, New York, and the Rachet Rover Railway company has been organized with a capital stock of $350,000 to construct and operate the same.

Upper Sandusky, O., is mentioned as the starting point of a 100 mile electric system, to pass through six county seats and smaller towns, and act as a feeder, in connection with a boat line, to northern Ohio lake resorts.

The cable line on the eastern portion of Seventh street, St. Paul, will be changed to electric, an ordinance for this purpose having passed the council. The cable line has been down several years, but as there is no severe grade on the line and as it has numerous electric branches, the change has become desirable.

The East St Louis Electric Street Railroad company has increased its capital stock to $500,000. With the proceeds of these bonds it will extend its railroad, erect a power house and supply the necessary machinery therefor and provide additional cars and equipment for the railroad and also provide for paying off and retiring its present outstanding five-twenty bonds.

The Chicago City Railway company has brought a suit against George H. Caxton to prevent him from moving a house across its tracks on Forty-seventh street, Chicago. It is alleged that as the house is twenty-eight feet high it will be necessary to cut the trolley wires and if this were done the company would suffer great damage, as the traffic of the road would be delayed for many hours.

The Cleveland Electric Railway company is meeting with the opposition of the city council in regard to the recent consolidation of street railways. The companies have consolidated without the consent of the council and without giving it an opportunity to fix any terms and conditions, and the board will begin proceedings in the courts to determine the legality of such consolidation.

The franchises and rights of way have been secured for an electric railway, to connect Van Buren, Ark., and Fort Smith. The proposed road will be 10 miles in length, and will bridge the Arkansas River at Fort Smith. The same company which proposes to construct this route has also bought the franchises of the Fort Smith Street Car company, and intends to belt the city with a line independent of the line to Van Buren.

Application has been made for a charter for the Paint Rock & Tennessee River Railway company. It is proposed to build an electric railway line from Winchester, Franklin county, Tenn., to McMinnville, by the way of Decherd, Viola and Beersheba Springs. The line is also to be extended to the head of Estill Rock Creek, of Paint Rock River, thence to Savannah, Mineral Springs, Lynchburg, Pulaski, Lawrenceburg and Waynesboro, in Wayne county.

Application has been made for a charter for the Robertson Southern Electric company in Tennessee to build an electric railway from Knoxville to Kingston, Oliver Springs, Popular Creek coal mines, Clinton, Andersonville, Powell's Valley, Lutrell, Maynardsville, Blaine's Cross Roads, Lee Springs, Strawberry Plains, Dandridge, Sevierville, Allegheny Springs and the Little Tennessee river. The company expects to handle both passengers and freight, and in effect to eventually construct a cheap system of railways through all East Tennessee.

The application of the Consolidated Traction company for use of twenty-six miles of streets in Newark, N. J., is believed to be part of a plan arranged by that company, which has its head in New York city, and a Philadelphia syndicate to complete a system of lines connecting Jersey City with Philadelphia. It has been pointed out that by degrees franchises have been obtained connecting Jersey City with Newark, thence by easy stages to Paterson, Elizabeth, and even to Trenton. The Philadelphia syndicate is reaching out toward Trenton, where the two roads are expected to combine. It is said that not less than $80,000,000 capital is behind the enterprise. From the principal line thus established spurs are contemplated reaching through every suburban village and town, making in fact, a huge gridiron of trolley lines through the state. It has been computed that the railroad privileges thus sought are worth fully $100,000,000.

TELEPHONE.

The Missouri, Kansas & Texas Telephone company will try the long distance telephone in sending messages as a substitute for the telegraph system.

TELEGRAPH.

South America and Africa have been joined by a new cable from Cape St. Augustin, Brazil, to the western extremity of Africa, the cable terminus at that point being near Cape Verde and the mouth of the river Senegal. The distance thus traversed is about 2,500 miles; and at the African station connection is made with the Spanish line by way of the Canary Islands to Cadiz and thus to all parts of Europe. Dispatches can now be sent from Pernambuco to Paris and London.

The survey for a cable from the shores of California to the Hawaiian Islands has resulted in a route being chosen starting from Monterey Bay to Honolulu, in preference to a route connecting Point Conception, Cal., and Hilo Bay, Hawaii, which was laid out by soundings by the steamer "Thetis," U. S. N., some time ago. The way selected will require the smallest length of wire and passes over an even bottom of soil favorable for the protection and preservation of the cable, avoiding submarine mountains.

POWER TRANSMISSION.

R. M. Jones has obtained a franchise to use the streets, alleys and highways of Salt Lake City, Utah, for poles, wires, pipes and conduits for the transmission of electricity from Big Cottonwood canyon.

Capitalists who are interested in an electric light plant in San Bernardino, Cal., have been at work for some months past on a project designed to supply the city of Los Angeles, Cal., with electric power for lighting the city, for use on the electric railways and for manufacturing purposes. Near the head waters of the San Gabriel river they have located a ditch and tunnel which develops, according to careful estimates, 3,000 horse power in a fall of 700 feet. By combining two streams it is estimated that 2,500 inches of water may be used and returned to the bed of the stream for the irrigators below. Negotiations are well under way for the disposal of the power.

MISCELLANEOUS.

At the meeting of the stockholders of the E. W. Bliss Manufacturing company, Brooklyn, held recently, it was decided to increase the capital stock of the company. The stock is now $1,000,000 preferred, and $1,000,000 common stock. The object of the increase in the stock was to take up the English bonds of the company and to reduce the large expenses of keeping an English agency for the company. The stock of the company is now almost entirely in the hands of local investors.

TRADE NEWS.

The Sperry Electric Railway, company, Cleveland, O., has issued a little book descriptive of its line of work. The company has introduced some novel ideas in the construction of its apparatus and these are here fully described and illustrated. Useful tables and instructions complete a book which will prove of profit and interest to those who are associated with electric railway construction.

The Electric Heat Alarm company, Boston, Mass., is distributing its latest catalogue. In it is described its automatic fire alarm system for hotels, calling attention in the office to the room in which the fire may be located. The company's exhibit at the World's Fair is attracting considerable interest, and it has no reason to complain of lack of attention.

The Ansonia Electric company has recently published a little circular describing the Wirt dimming switch, which is a great convenience in a bedroom or nursery for dimming the light. The company reports a large sale in the last month of Habirshaw wire, and also announces that it has closed a contract for upward of forty miles of shield brand wire for lighting and power work.

The *Architects' Electrical Bulletin*, New York, is devoting considerable attention to the task of advancing practical knowledge of electric light wiring among architects. It believes that there are many architects who have not devoted enough time and thought to wiring requirements. Hoping to remedy this to a certain extent, it makes a proposition to the profession declaring its willingness to establish a department for the purpose of drawing up wiring specifications. If architects will send their plans to the company, with the location of the outlets and lights marked, the new department will go over the plans, lay out the conduit system and draw a full specification for the wiring in question free of expense. Another advantage this offers, in addition to the specifications themselves, is the fact that it will enable patrons to obtain the benefit of all improvements that are made from time to time, and that cannot be brought before the public for some months after adoption in New York and other large cities.

If, as the American Silk Manufacturing company states in one of its circulars, "every new invention has to overcome prejudice, established customs and adopted habits," it may be safely inferred that this company will rapidly overcome such obstacles. Already it has been found necessary to warn the public of an attempt at imitation. The American Silk Manufacturing company's machine wipers are made of pure raw silk waste, strongly woven and warranted to last for a long time. Imitation wipers, which are not so durable and are spontaneously combustible, are on the market and must not be confounded with the original article. The factory of the company has been removed from St. Louis, Mo., to Bucks county, Pa., where excellent facilities for manufacturing and transportation were obtainable.

The General Electric company has issued a finely executed folder to be used especially in connection with its exhibit at the World's Fair. It has forty-nine descriptive illustrations showing some of the more important appliances which the company manufactures. It also shows the illuminations and decorative lighting at the fair including many buildings, McMonnie's fountains, the basin and electric fountains, search-lights and applications of electricity to many branches of business. The showing of the first incandescent central station in comparison with one 11 years later illustrates the immense growth of this branch of the business. The folder is a very attractive piece of work and much credit is due to Luther Stieringer who gave the ideas, and J. McGhie for the careful compiling and pleasing arrangement of the matter, while the handsome designs and press work are from Bartlett & Co.

BUSINESS.

The Ansonia Electric company, Chicago, is pushing the Stanley transformer with sufficient energy to make it a noteworthy success. Another specialty that the company evidently intends shall be kept before the public is the W. W. lightning arrester. Both these articles are in wide use, and the company is constantly receiving flattering testimonials as to their efficiency.

The Manhattan Electric Supply company, 36 Cortlandt street, New York, is making a special feature of its telephones. Already the expected results of the expiration of the Bell telephone patent has been the cause for unusual activity in the telephone branch of the electrical supply business, and the Manhattan company is one of the first to solicit orders for delivery after January 30, 1894, when the patent broadly covering a telephone receiver expires.

One who would see the beautiful, unique and practical in arc lamps and fixtures should consult catalogue No. 1 of the General Incandescent Arc Light company, New York. This company has established a well-deserved reputation for progressiveness and the numerous additions to its previous circular will be seen at a glance. It may be safely taken for granted that the company will not cease to make improvements in details and that success will attend it proportionately in the future as in the past.

Queen & Co., incorporated, Philadelphia, report a large stock of "magnetic vane" ammeters and volt meters which they can ship promptly and are pushing with great vigor. These instruments combine qualities highly essential for switchboard use and which render them specially valuable for isolated plants. A number have been shipped to exhibiting companies for installations at the World's Fair, and the makers have a handsome collection in their own display. The Acme portable testing set has met with favor wherever shown and is sure to become popular for general testing.

The Electrical Engineering & Supply company will, on July 1st, have removed its entire stock and business from St. Paul to Minneapolis, and will be located in commodious quarters at 249 Second avenue south. The name of the company will be shortened for convenience and called the Electrical Engineering company. Its new headquarters being much larger than at present it will have every facility for handling supplies with great promptness, and will also furnish factory facilities for the Northwestern Packard Lamp company, whose entire output, a capacity for at least 1,000 lamps per day, will be handled exclusively by the Electrical Engineering company.

The Electric Appliance company is offering two new attractions in the incandescent lamp business. One is a lamp of lower candle power than heretofore usual and the other a lamp of higher candle power than has as yet been produced. The first is its 6 candle power lamp made to fit any regular socket and burn on regular circuits with the filament at the incandescence of an ordinary 16 candle power lamp. The improvement in the other direction is in an incandescent lamp up to 1000 candle power and of a very high efficiency. The Electric Appliance company hopes very shortly to have one of these thousand candle power lamps burning in its World's Fair exhibit. These lamps are the Packard lamps manufactured by the New York & Ohio company for whom the Electric Appliance company is the western agent. From the interest that is being manifested in the new lamps the manufacturer has reason to believe that they will soon be in extensive use.

ELECTRICAL PATENTS.

Issued June 13, 1893.

499,253. Process of Magnetic Separation and Apparatus Therefor. Richard H. Sanders and Charles T. Thompson, Philadelphia, Pa.

499,261. Burglar Alarm System. Alfred Stromberg, Chicago, Ill.

499,270. Safety Support for Trolley Wires. Hiram K. Whitner, Chicago, Ill.

499,275. Safety Device for Systems of Distribution. Herbert C. Wirt, Boston, Mass.

The safety device is particularly designed for high tension systems, as, for example, alternating current transformer systems. At a point of the armature of the generator, midway electrically between the terminals of the machine, a connection is made from the coils to a third collecting ring, whose brush is permanently connected to ground. Thus, when the line is grounded through the body, the current that traverses the body will have only half the potential of the machine.

499,277. Method of and Apparatus for Uniting Metals. John H. Bassler, Myerstown, Pa.

The method consists in placing a fillet of aluminum or aluminum alloy in the joint of the materials to be united, and then passing an electric current through the materials and through the fillet transversely of the joint until the fillet is fused.

499,297. Electric Gas Lighting Apparatus. Thomas W. Lane, Boston, Mass., and Charles E. Lee, Chicago, Ill.

499,298. Electric Gas Lighting Apparatus. Thomas W. Lane, Boston, Mass.

499,305. Electric Bell. John L. Moore, New York, N. Y.

499,313. Electrical Measuring Instrument. Edward Weston, Newark, N. J.

499,321. System of Propelling Canal Boats by Electricity. Samuel W. Gear, Buffalo, N. Y.

A conducting wire is supported over the waterway, and so arranged that it may readily be shifted laterally in accordance with the lateral movement of the boat.

499,363. Electric Switch. James F. McElroy, Albany, N. Y.

499,370. Phonograph. William Bruening, East Orange, N. J.

499,374. Conduit Electric Railway. William R. De Voe, Shreveport, La.

499,411. Electric Signaling Apparatus for Elevators. Charles G. Armstrong, Chicago, Ill.

499,425. Strong Current Protector. Charles D. Haskins, Brooklyn, N. Y.

499,428. Electric Hinge. William S. Hull, Sheffield, Ala.

499,446. Alternating Current Generator. William Stanley, Jr., and John F. Kelly, Pittsfield, Mass.

499,461. Overhead Trolley Wire Switch. Rudolph M. Hunter, Philadelphia, Pa.

499,473. Electric Light. Gaston Sautter, Paris, France.

499,485. Relay Fuse Block. Gardner T. Voorhees, Boston, Mass.

499,518. Method of Electrically Welding Metals. Charles L. Coffin, Detroit, Mich.

499,543. Electro-magnetic Car Brake. John C. Henry, Westfield, N. J.

One of the axles on each car is supplied with a combined dynamo and magnetic clutch. Ordinarily no current is generated by the dynamo, but, by closing the circuit across the dynamo terminals, either automatically or mechanically, the generator induces an alternating current which excites powerful magnets that operate the magnetic clutch, thereby causing a drum, normally loose on the axle, to wind up the brake chain.

499,544. Regulator for Electric Machines. John C. Henry, Westfield, N. J.

The regulator is adapted to shift the brushes upon the commutator to vary the potential of the machine and maintain the current strength constant. To the armature shaft is attached a disc of magnetic material, which is adapted to rotate between the poles of an electro-magnet, which is supported upon a pivot. The pivoted electro-magnet is connected by levers with the brush carrier, so that by its rotation it shifts the brushes upon the commutator. The coils of the electro-magnet are in series with the working circuit, and any increase in the strength of the current causes an increased attraction upon the rotating disc, thus moving the pivoted magnet upon its pivot and shifting the brushes to a position where the potential of the machine is lessened.

499,596. Electric Igniting Device. William H. Russell and George E. Russell, Jersey City, N. J.

499,610. Recorder. John T. Todd, Chicago, Ill.

499,614. Multiple Fuse Block. Gardner T. Voorhees, Boston, Mass.

499,633. Gearing for Electric Railway Cars. John C. Henry, New York, N. Y.

499,646. Switch. George W. Russell, Jr., Denver, Colo.

499,657. Method of and Apparatus for Electrically Welding Sheet Metal. Charles L. Coffin, Detroit, Mich.

499,662. Trolley Wire Hanger. Charles B. Elliott, Boston, Mass.

499,664. Electric Fuse Block. Thomas J. Fay, New York, N. Y.

499,676. Electric Arc Lamp. Rudolph M. Hunter, Philadelphia, Pa.

The lamp is adapted to burn several pairs of carbons successively. The lower carbons occupy parallel positions, while the upper carbons, supported by the same carbon rod, occupy positions so parallel that but one of the carbons may come in line with the other member of the pair at a time. Lifting and regulating mechanism is provided whereby the arc is established and maintained between one of the pairs until the arc becomes extinguished, when the carbon rod is lifted and rotated until the members of the second pair are brought into line, after which the arc is established and maintained between the latter pair.

499,681. Electro-magnetic Blanket. Nils A. Renstrom, Omaha, Neb.

499,693. System of Wiring Multiple Switchboards. Charles H. Wilson, Chicago, Ill.

The cables connected with the various spring-jack switches are located at the back of the board, and supported upon horizontal pins or arms. In order that any strip of spring-jacks may be readily withdrawn from the board slack is provided in each cable by running the cables in sinuous lines, the conducting wires extending to the switches, leaving the cables at those portions of the cable lying nearest the board, so that when the strip of switches connected therewith is withdrawn from the board sufficient slack cable is provided to permit the withdrawal to the rear of the mass of cables.

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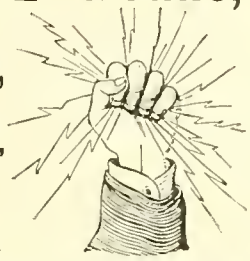

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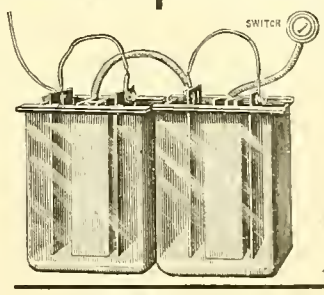

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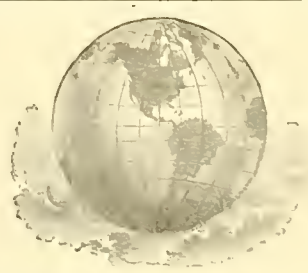

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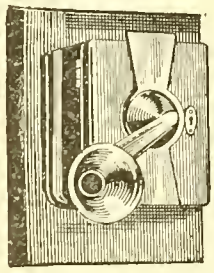

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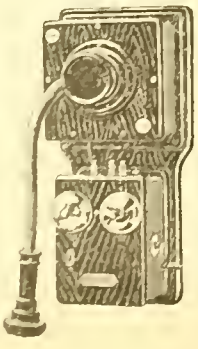

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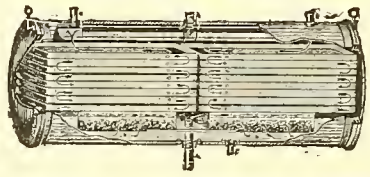

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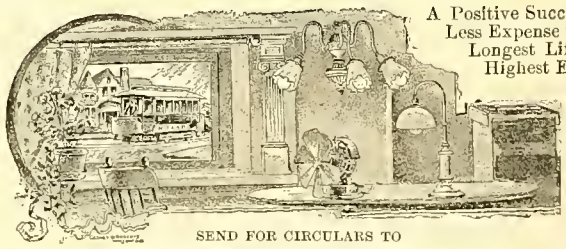

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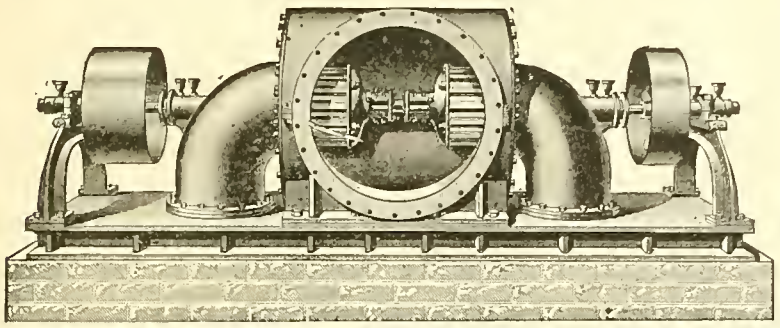

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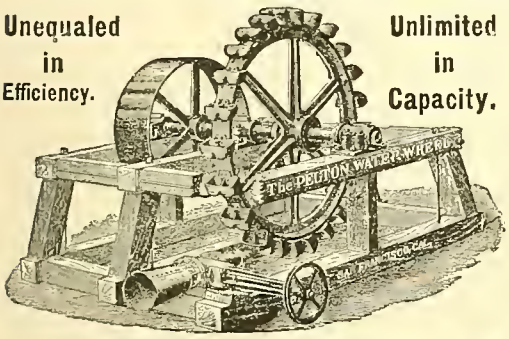

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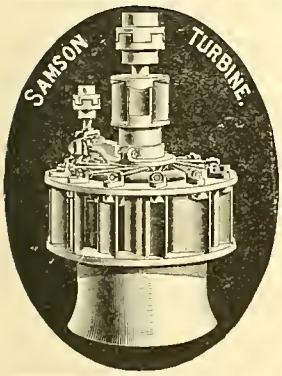

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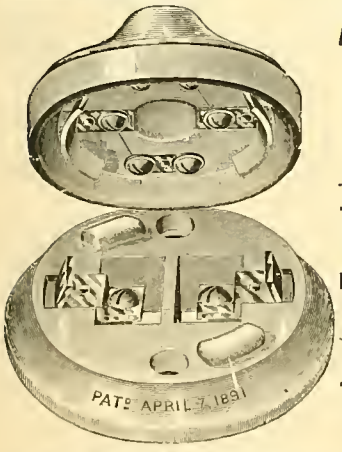

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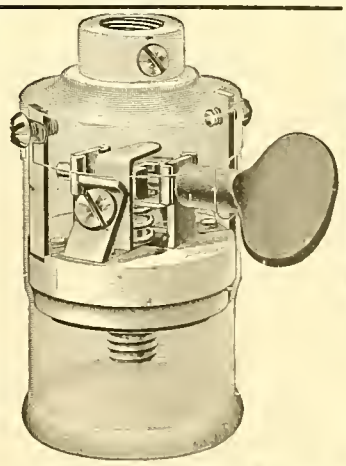

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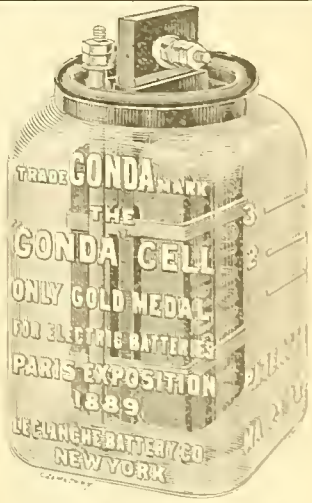

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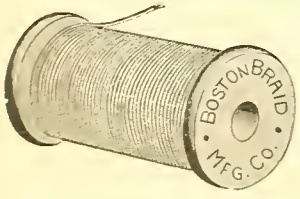

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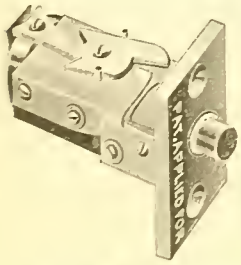

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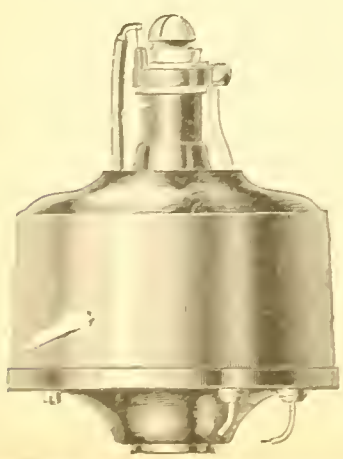

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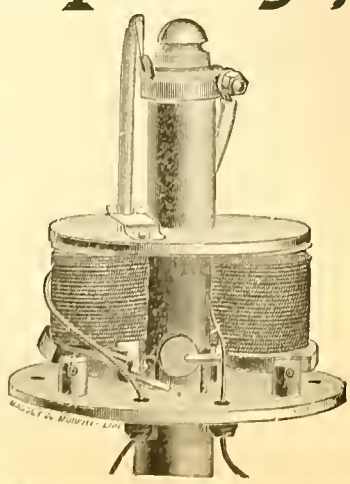

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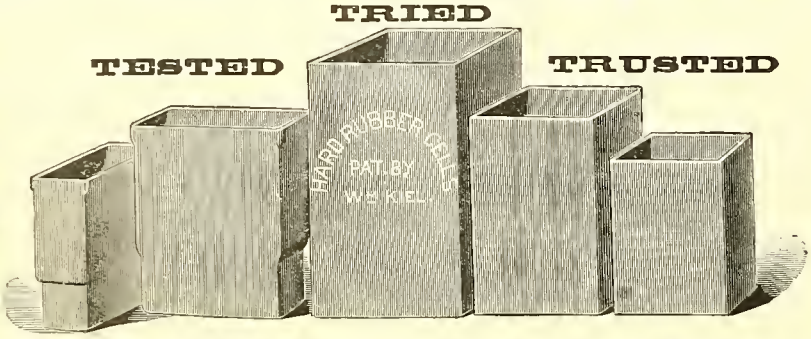

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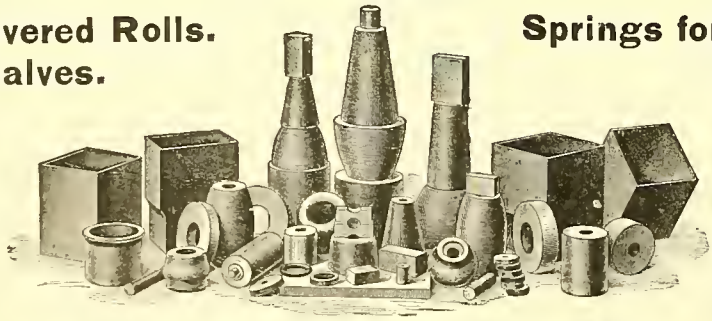

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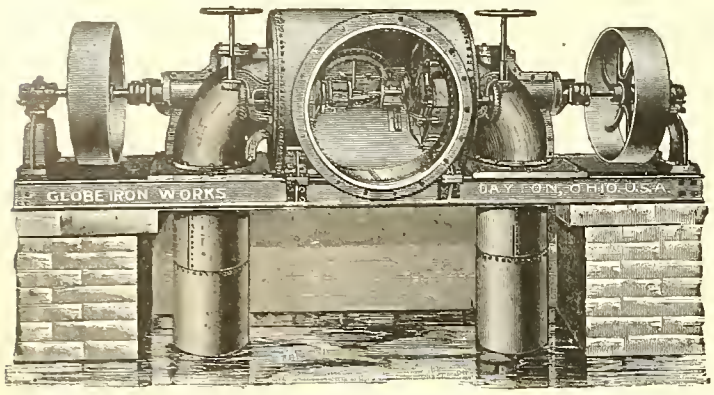

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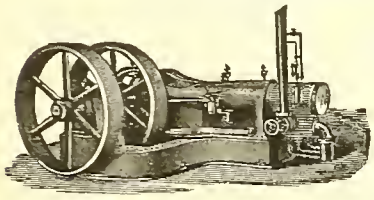

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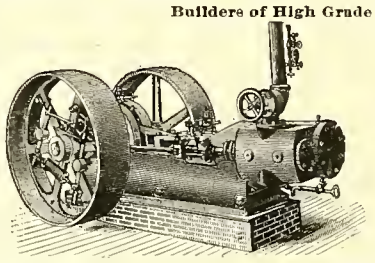

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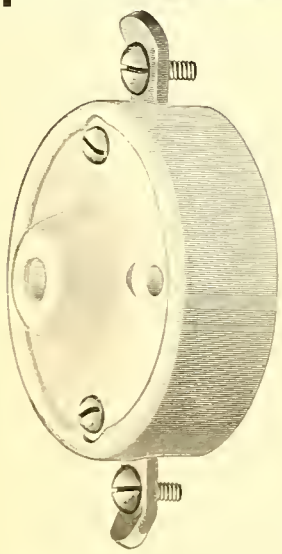

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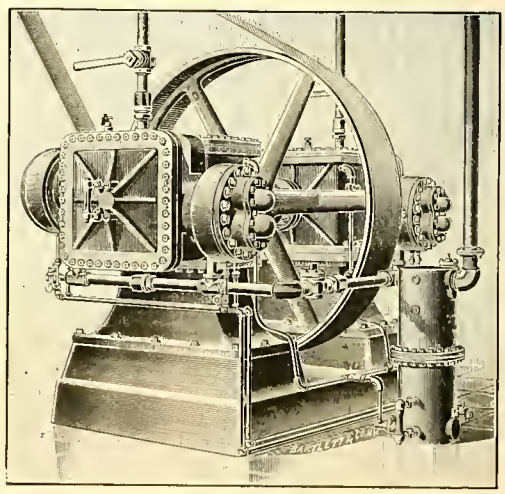

ARTIFICIAL ICE

having any capacity from one-half ton to one hundred tons per day and upward. Artificial Ice has come to stay, equally for sanitary and economic reasons, and its manufacture is a stable and profitable enterprise, competing successfully against the natural product.

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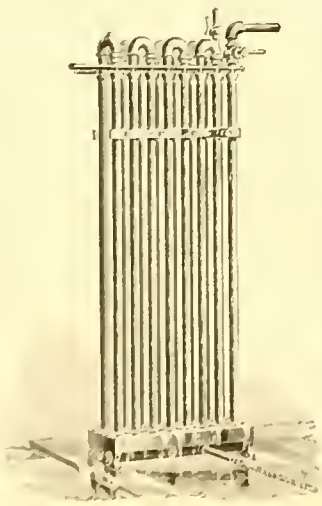

will receive our especial attention. In cold Storage Warehouses, Breweries, Packing Houses, and similar large industries, it is already an established necessity. Into this class of plants we bring for the first time the manifest advantages of small space and headroom, and the subdivision of units, which last is the only means whereby a Refrigerating Plant can meet the fluctuation of the seasons with anything like uniform efficiency.

Refrigeration or combined Refrigeration and Ice-making, in small plants from one-half ton to ten tons per day, is now cheap and practicable, and this particular trade will be fully developed by us in its application to Markets, Creameries, Hotels, Apartment Houses, Hospitals, and Manufacturing processes of all kinds. In this latter field, we believe ourselves without successful competition.

Correspondence regarding any application of Artificial Cold will be to the mutual advantage of our customers and ourselves.

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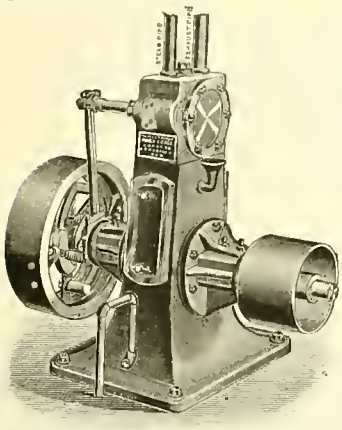

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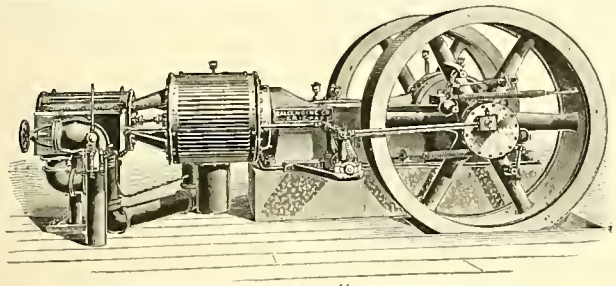

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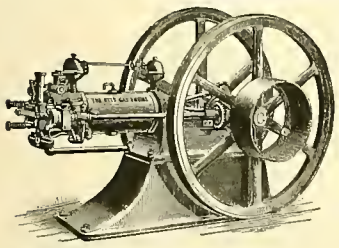

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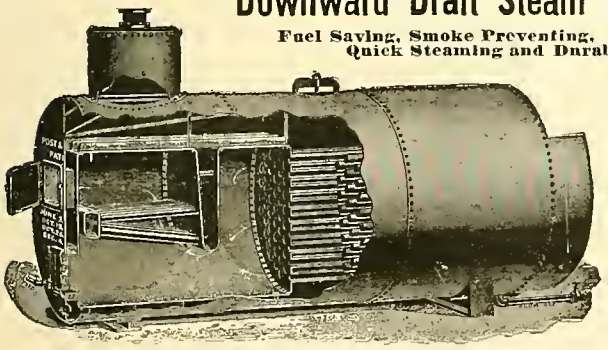

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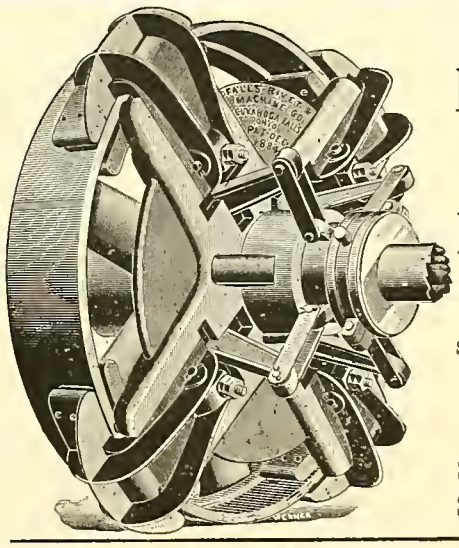

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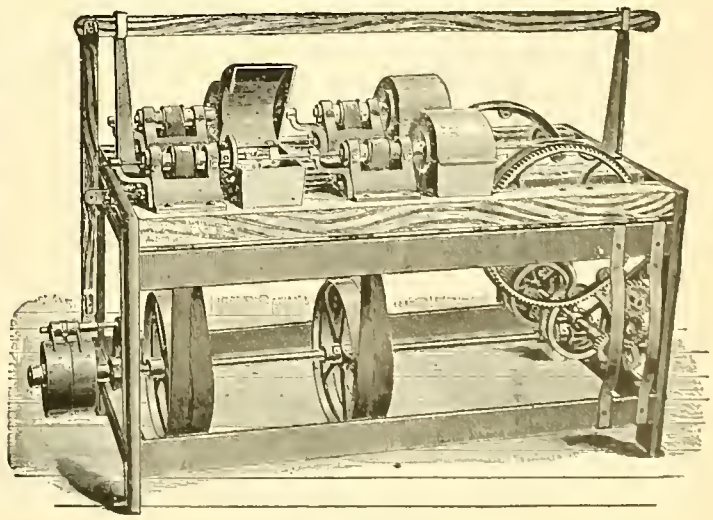

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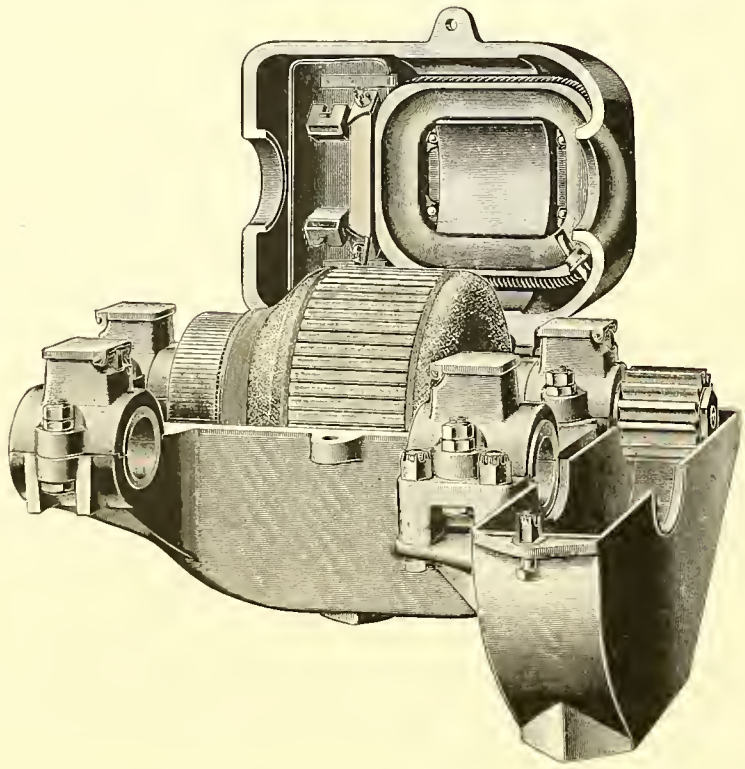

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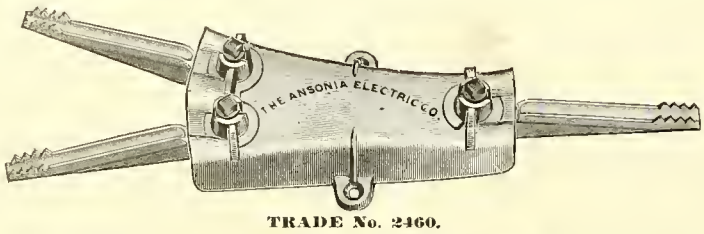

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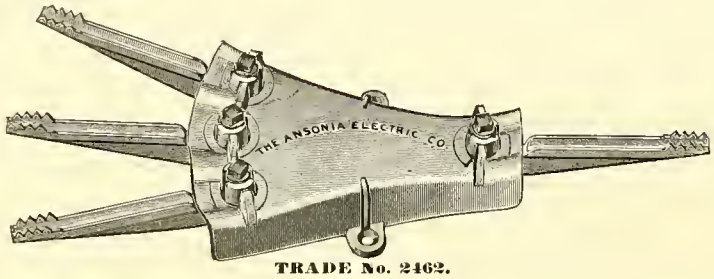

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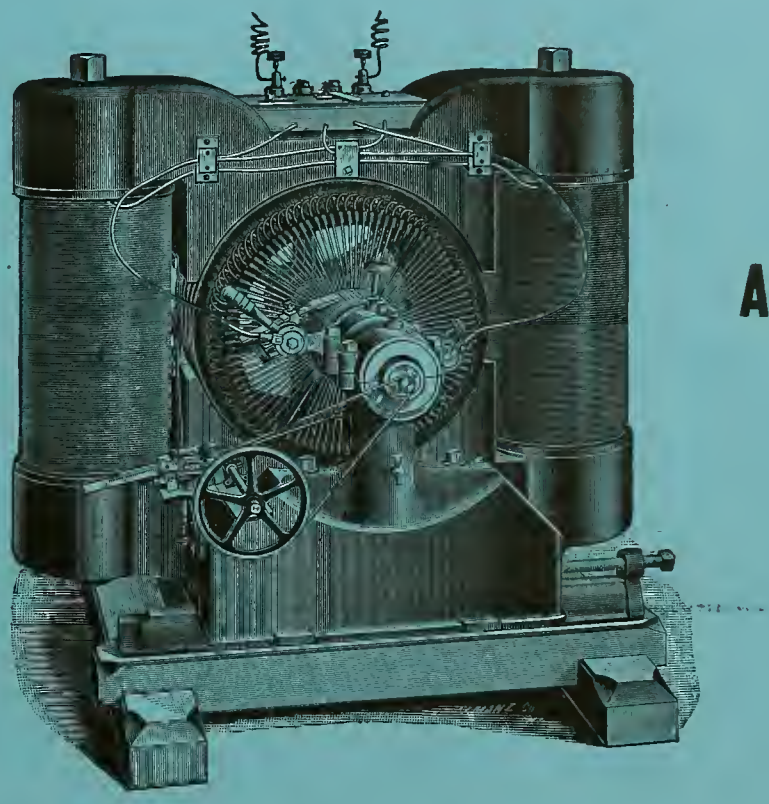

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